PROJECT MANUAL FOR CONSTRUCTION OF

SUPREME COURT OF MARYLAND

Rowe Boulevard
Annapolis, MD
Anne Arundel County
DGS Project #BA-688-200-001
Project Classification H

PROJECT SPECIFICATIONS

Volume 1 of 4: Divisions 00 - 09

Issue for Bid
December 1, 2023

DEPARTMENT OF GENERAL SERVICES
Atif Chaudhry, Secretary
301 West Preston Street, Room 1405
Baltimore, MD 21201

Board of Public Works
Wes Moore, Governor
Brooke Elizabeth Lierman, Comptroller
Dereck E. Davis, Treasurer

Maryland
DEPARTMENT OF GENERAL SERVICES

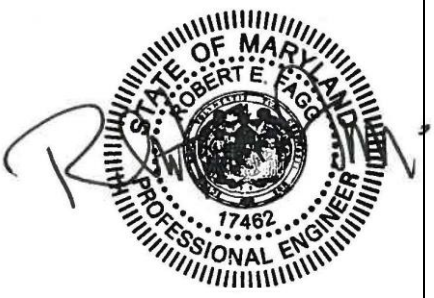
SUPREME COURT OF MARYLAND

FENTRESS ARCHITECTS

"Minority Business Enterprises are encouraged to respond to this solicitation."

This page is intentionally left blank.

SECTION 00 01 07 - SEALS PAGE

		
ARCHITECT OF RECORD	CIVIL ENGINEER	STRUCTURAL ENGINEER
 12/1/2023	 12/1/2023	 12/1/2023
FIRE PROTECTION	PLUMBING ENGINEER	MECHANICAL ENGINEER
 12/1/2023	 12/1/2023	
ELECTRICAL ENGINEER	TECHNOLOGY & AV ENGINEER	LANDSCAPE ARCHITECT

END OF SEALS PAGE

This page is intentionally left blank.

SECTION 00 01 10 - TABLE OF CONTENTS

Issue No.	**Issue Title**	**Issue Date**
Issue 1:	Issue for Bid	December 1, 2023

Legend:
X = First Issue for Bid
O = Reissue (unchanged)
R = Revised for this Package
W = Withdrawn
-- = Not Reissued for this Package

SECTION NUMBER	SECTION TITLE	Author	ISSUE NUMBER							
			1	2	3	4	5	6	7	8
DIVISION 00 - PROCUREMENT AND CONTRACTING REQUIREMENTS										
00 01 07	Seals Page	FA	X							
00 01 10	Table of Contents	FA	X							
DIVISION 00 – PROCUREMENT AND CONTRACTING REQUIREMENTS										
Division 00	Procurement and Contracting Requirements	DGS	X							
DIVISION 01 - GENERAL REQUIREMENTS										
01 10 00	Summary	FA	X							
01 21 00	Allowances	FA	X							
01 22 00	Unit Prices	FA	X							
01 23 00	Alternates	FA	X							
01 25 00	Substitution Procedures	FA	X							
01 26 00	Contract Modification Procedures	FA	X							
01 29 00	Payment Procedures	FA	X							
01 31 00	Project Management and Coordination	FA	X							
01 31 00A	Digital Data Licensing and Indemnification Exhibit – Appendix A	FA	X							
01 32 00	Construction Progress Documentation	FA	X							

SECTION NUMBER	SECTION TITLE	Author	ISSUE NUMBER							
			1	2	3	4	5	6	7	8
01 33 00	Submittal Procedures	FA	X							
01 40 00	Quality Requirements	FA	X							
01 42 00	References	FA	X							
01 43 39	Mockups	FA	X							
01 50 00	Temporary Facilities and Controls	FA	X							
01 50 10	Temporary Facilities and Controls - State Field Office	FA	X							
01 56 39	Temporary Tree and Plant Protection	AMT	X							
01 60 00	Product Requirements	FA	X							
01 73 00	Execution	FA	X							
01 74 19	Construction Waste Management and Disposal	FA	X							
01 74 19 EVA	Form CWM-1: Construction Waste Identification	FA	X							
01 74 19 EVB	Form CWM-2: Demolition Waste Identification	FA	X							
01 74 19 EVC	Form CWM-3: Construction Waste Reduction Work Plan	FA	X							
01 74 19 EVD	Form CWM-4: Demolition Waste Reduction Work Plan	FA	X							
01 74 19 EVE	Form CWM-5: Cost/Revenue Analysis of Construction Waste Reduction Work Plan	FA	X							
01 74 19 EVF	Form CWM-6: Cost/Revenue Analysis of Demolition Waste Reduction Work Plan	FA	X							
01 74 19 EVG	Form CWM-7: Construction Waste Reduction Progress Report	FA	X							
01 74 19 EVH	Form CWM-8: Demolition Waste Reduction Progress Report	FA	X							
01 77 00	Closeout Procedures	FA	X							
01 78 23	Operation and Maintenance Data	FA	X							
01 78 39	Project Record Documents	FA	X							
01 79 00	Demonstration and Training	FA	X							
01 81 13.14	Sustainable Design Requirements – LEED v4 BD+C, New Construction	FA	X							
01 81 13.14A	LEED Matrix - Appendix A	FA	X							

SECTION NUMBER	SECTION TITLE	Author	ISSUE NUMBER							
			1	2	3	4	5	6	7	8
01 81 13.14B	LEED Scorecard - Appendix B	FA	X							
01 81 13.14C	LEEDv4.1 Materials Submittal Form - Appendix C	FA	X							
01 91 13	General Commissioning Requirements [to be provided at later date]	DGS								
DIVISION 02 – EXISTING CONDITIONS										
02 41 19	Selective Demolition	FA	X							
DIVISION 03 – CONCRETE										
03 10 00	Concrete Forming and Accessories	HFA	X							
03 30 00	Cast-in-Place Concrete	HFA	X							
03 45 00	Precast Architectural Concrete	FA	X							
DIVISION 04 – MASONRY										
04 01 40.99	Relocation Reuse and Restoration of Latrobe Marble Columns	FA	X							
04 22 00	Concrete Unit Masonry	FA	X							
DIVISION 05 – METALS										
05 05 19	Post Installed Anchors	HFA	X							
05 12 00	Structural Steel Framing	HFA	X							
05 31 00	Steel Decking	HFA	X							
05 40 00	Cold-Formed Metal Framing	FA	X							
05 50 00	Metal Fabrications	FA	X							
05 51 13	Metal Pan Stairs	FA	X							
05 51 19	Metal Grating Stairs	FA	X							
05 52 13	Pipe and Tube Railings	FA	X							

SECTION NUMBER	SECTION TITLE	Author	ISSUE NUMBER							
			1	2	3	4	5	6	7	8
05 53 13	Bar Gratings	HFA	X							
05 58 13	Column Covers	FA	X							
05 70 00	Decorative Metal	FA	X							
05 71 00	Decorative Metal Stairs	FA	X							
05 73 00	Decorative Metal Railings	FA	X							
05 73 13	Glazed Decorative Metal Railings	FA	X							
05 75 00	Decorative Formed Metal	FA	X							
DIVISION 06 – WOOD, PLASTICS, AND COMPOSITES										
06 01 40.99	Relocation, Reuse, and Restoration of Historic Courtroom Woodwork	FA	X							
06 10 00	Rough Carpentry	FA	X							
06 16 00	Sheathing	FA	X							
06 40 23	Interior Architectural Woodwork	FA	X							
06 41 13	Wood-Veneer-Faced Architectural Cabinets	FA	X							
06 41 16	Plastic-Laminate-Clad Architectural Cabinets	FA	X							
06 42 14	Stile and Rail Wood Paneling	FA	X							
06 44 00	Ornamental Woodwork	FA	X							
06 64 00	Plastic Paneling	FA	X							
06 83 13	Fiber-Reinforced Plastic Paneling	FA	X							
DIVISION 07 – THERMAL AND MOISTURE PROTECTION										
07 05 43.13	Rainscreen Cladding Support Systems	FA	X							
07 11 13	Bituminous Dampproofing	FA	X							
07 13 26	Self-Adhering Sheet Waterproofing	FA	X							
07 14 13	Hot Fluid-Applied Rubberized Asphalt Waterproofing	FA	X							

SECTION NUMBER	SECTION TITLE	Author	ISSUE NUMBER							
			1	2	3	4	5	6	7	8
07 16 16	Crystalline Waterproofing	FA	X							
07 18 00	Traffic Coatings	FA	X							
07 19 00	Water Repellents	FA	X							
07 21 00	Thermal Insulation	FA	X							
07 21 19	Foamed-In-Place Insulation	FA	X							
07 27 13	Modified Bituminous Sheet Air Barriers	FA	X							
07 42 13.13	Formed Metal Wall Panels	FA	X							
07 54 19	Polyvinyl-Chloride (PVC) Roofing	FA	X							
07 62 00	Sheet Metal Flashing and Trim	FA	X							
07 72 00	Roof Accessories	FA	X							
07 72 73	Vegetated Roof Systems	FA	X							
07 81 00	Applied Fire Protection	FA	X							
07 84 13	Penetration Firestopping	FA	X							
07 84 43	Joint Firestopping	FA	X							
07 92 00	Joint Sealants	FA	X							
07 92 19	Acoustical Joint Sealants	FA	X							
DIVISION 08 – OPENINGS										
08 11 13	Hollow Metal Doors and Frames	FA	X							
08 14 16	Flush Wood Doors	FA	X							
08 14 33	Stile and Rail Wood Doors	FA	X							
08 31 13	Access Doors and Frames	FA	X							
08 33 23	Overhead Coiling Doors	FA	X							
08 33 43	Overhead Coiling Smoke Curtains	FA	X							
08 41 26.23	Interior All-Glass Entrances	FA	X							

SECTION NUMBER	SECTION TITLE	Author	ISSUE NUMBER							
			1	2	3	4	5	6	7	8
08 44 13	Glazed Aluminum Curtain Walls	FA	X							
08 56 53	Security Windows	FA	X							
08 63 00	Metal-Framed Skylights	FA	X							
08 71 00	Door Hardware	DMK/FA	X							
08 71 13	Power Door Operators	FA	X							
08 75 16	Window Operators	FA	X							
08 80 00	Glazing	FA	X							
08 81 13	Decorative Glass Glazing	FA	X							
08 83 00	Mirrors	FA	X							
08 88 53	Security Glazing	FA	X							
08 91 19	Fixed Louvers	FA	X							
DIVISION 09 – FINISHES										
09 05 61.13	Moisture Vapor Emission Control	FA	X							
09 21 16.23	Gypsum Board Shaft Wall Assemblies	FA	X							
09 22 16	Non-Structural Metal Framing	FA	X							
09 23 13	Acoustical Gypsum Plastering	FA	X							
09 24 00	Cement Plastering	FA	X							
09 27 13	Glass-Fiber-Reinforced Gypsum Fabrications	FA	X							
09 29 00	Gypsum Board	FA	X							
09 30 13	Ceramic Tiling	FA	X							
09 51 13	Acoustical Panel Ceilings	FA	X							
09 64 00	Wood Flooring	FA	X							
09 65 13	Resilient Base and Accessories	FA	X							
09 65 19	Resilient Tile Flooring	FA	X							

SECTION NUMBER	SECTION TITLE	Author	ISSUE NUMBER							
			1	2	3	4	5	6	7	8
09 65 36	Static-Control Resilient Flooring	FA	X							
09 65 66	Resilient Athletic Flooring	FA	X							
09 66 23	Resinous Matrix Terrazzo Flooring	FA	X							
09 68 13	Tile Carpeting	FA	X							
09 75 13	Stone Wall Facing	FA	X							
09 75 23	Simulated Stone Wall Facing	FA	X							
09 84 33	Sound-Absorbing Wall Units	FA	X							
09 91 23	Interior Painting	FA	X							
09 96 11	High-Performance Coatings (Proprietary Specification)	FA	X							
DIVISION 10 – SPECIALTIES										
10 12 00	Display Cases	FA	X							
10 14 00	Signage	FA	X							
10 21 13.17	Phenolic-Core Toilet Compartments	FA	X							
10 22 13	Wire Mesh Partitions	FA	X							
10 22 39	Folding Panel Partitions	FA	X							
10 26 00	Wall and Door Protection	FA	X							
10 26 41	Bullet Resistant Panels	FA	X							
10 28 00	Toilet, Bath, and Laundry Accessories	FA	X							
10 43 13	Defibrillator Cabinets	FA	X							
10 44 13	Fire Protection Cabinets	FA	X							
10 44 16	Fire Extinguishers	FA	X							
10 45 13	Photoluminescent Egress Path Markings	FA	X							
10 51 13	Metal Lockers	FA	X							
10 51 16	Wood Lockers	FA	X							

SECTION NUMBER	SECTION TITLE	Author	ISSUE NUMBER							
			1	2	3	4	5	6	7	8
10 51 23	Plastic-Laminate-Clad Lockers	FA	X							
10 56 26	Mobile Storage Shelving	FA	X							
10 81 13	Bird Control Devices	FA	X							
DIVISION 11 – EQUIPMENT										
11 12 00	Vehicle Access Control Systems	M2H	X							
11 13 19	Stationary Loading Dock Equipment	FA	X							
11 19 16	Detention Gun Lockers	FA	X							
11 30 13	Residential Appliances	FA	X							
11 81 31	Facility Fall Protection and Facade Access Equipment	FA	X							
11 81 33	Mobile Scissor Lifts	FA	X							
DIVISION 12 – FURNISHINGS										
12 24 13	Roller Window Shades	FA	X							
12 36 23.13	Plastic-Laminate-Clad Countertops	FA	X							
12 36 61.19	Quartz Agglomerate Countertops	FA	X							
12 93 00	Site Furnishings	RHI	X							
DIVISION 14 – CONVEYING EQUIPMENT										
14 21 23.16	Machine Room-Less Electric Traction Passenger Elevators	FA	X							
14 27 00	Custom Elevator Cabs and Doors	FA	X							
DIVISION 21 – FIRE SUPPRESSION										
21 05 00	Common Work Results For Fire Suppression	ME-E	X							
21 08 00	Commissioning Of Fire Suppression System	ME-E	X							

SECTION NUMBER	SECTION TITLE	Author	ISSUE NUMBER							
			1	2	3	4	5	6	7	8
21 13 00	Fire Suppression Sprinkler Systems	ME-E	X							
21 13 19	Preaction Suppression Systems	ME-E	X							
21 90 00	Fire Suppression System Project Closeout	ME-E	X							
DIVISION 22 – PLUMBING										
22 00 00	Basic Plumbing Requirements	WFT	X							
22 05 13	Common Motor Requirements for Plumbing Equipment	WFT	X							
22 05 16	Expansion Fittings and Loops for Plumbing Piping	WFT	X							
22 05 17	Sleeves and Sleeve Seals for Plumbing Piping	WFT	X							
22 05 18	Escutcheons for Plumbing Piping	WFT	X							
22 05 19	Meters and Gages for Plumbing Piping	WFT	X							
22 05 23.12	Ball Valves for Plumbing Piping	WFT	X							
22 05 23.13	Butterfly Valves for Plumbing Piping	WFT	X							
22 05 23.14	Check Valves for Plumbing Piping	WFT	X							
22 05 23.15	Gate Valves for Plumbing Piping	WFT	X							
22 05 29	Hangers and Supports for Plumbing Piping and Equipment	WFT	X							
22 05 48.13	Vibration Controls for Plumbing Piping and Equipment	WFT	X							
22 05 53	Identification for Plumbing Piping and Equipment	WFT	X							
22 05 93	Testing, Adjusting, and Balancing for Plumbing	WFT	X							
22 07 16	Plumbing Equipment Insulation	WFT	X							
22 07 19	Plumbing Piping Insulation	WFT	X							
22 11 16	Domestic Water Piping	WFT	X							
22 11 19	Domestic Water Piping Specialties	WFT	X							
22 11 23.13	Domestic Water Packaged Booster Pumps	WFT	X							
22 11 23.21	Inline, Domestic-Water Pumps	WFT	X							

SECTION NUMBER	SECTION TITLE	Author	ISSUE NUMBER							
			1	2	3	4	5	6	7	8
22 12 23.11	Facility Indoor Potable Water Storage Tanks	WFT	X							
22 13 13	Facility Sanitary Sewers	AMT	X							
22 13 16	Sanitary Waste and Vent Piping	WFT	X							
22 13 19	Sanitary Waste Piping Specialties	WFT	X							
22 13 19.13	Sanitary Drains	WFT	X							
22 13 23	Sanitary Waste Interceptors	WFT	X							
22 14 13	Facility Storm Drainage Piping	WFT	X							
22 14 23	Storm Drainage Piping Specialties	WFT	X							
22 14 29	Sump Pumps	WFT	X							
22 32 00	Domestic Water Filtration Equipment	WFT	X							
22 33 00	Electric, Domestic-Water Heaters	WFT	X							
22 42 13.13	Commercial Water Closets	WFT	X							
22 42 13.16	Commercial Urinals	WFT	X							
22 42 16.13	Commercial Lavatories	WFT	X							
22 42 16.16	Commercial Sinks	WFT	X							
22 42 23	Commercial Showers	WFT	X							
22 45 00	Emergency Plumbing Fixtures	WFT	X							
22 47 16	Pressure Water Coolers	WFT	X							
DIVISION 23 – HEATING, VENTILATING, AND AIR CONDITIONING (HVAC) *Refer To Alternates List For Applicable Sections										
23 05 01*	Mechanical and Electrical Coordination 23 05 01 and 26 05 01	ME-E	X							
23 05 02	Basic Mechanical Requirements	ME-E	X							
23 05 03	Basic Mechanical Materials and Methods	ME-E	X							
23 05 04	Corrosion Protection from Humid Salt-Laden Outdoor Air	ME-E	X							
23 05 13	Motors and Starters	ME-E	X							

SECTION NUMBER	SECTION TITLE	Author	ISSUE NUMBER							
			1	2	3	4	5	6	7	8
23 05 21	Pipe and Pipe Fittings	ME-E	X							
23 05 22	Piping Accessories	ME-E	X							
23 05 23	Valves	ME-E	X							
23 05 29	Pipe Supports and Anchors	ME-E	X							
23 05 30	Electronic Speed Controllers	ME-E	X							
23 05 48	Vibration Control	ME-E	X							
23 05 53	Mechanical Identification	ME-E	X							
23 05 93	Test-Adjust-Balance	ME-E	X							
23 07 00	Mechanical Insulation	ME-E	X							
23 08 00	Building Mechanical System Commissioning	ME-E	X							
23 08 01	Commissioning Agent Requirements	ME-E	X							
23 09 00	Building Automation and Automatic Temperature Control Systems	ME-E	X							
23 09 02	Life Safety Systems	ME-E	X							
23 09 03*	Smoke Management 23 09 03 and 28 46 10	ME-E	X							
23 21 13	Hydronic Piping	ME-E	X							
23 21 23	HVAC Pumps	ME-E	X							
23 23 00	Refrigerant Piping	ME-E	X							
23 25 13	HVAC System Chemical Treatment	ME-E	X							
23 31 13	Ductwork	ME-E	X							
23 33 00	Ductwork Accessories	ME-E	X							
23 34 00	Fans	ME-E	X							
23 36 00	Air Terminal Units	ME-E	X							
23 37 00	Air Inlets and Outlets	ME-E	X							
23 40 00	Air Cleaning	ME-E	X							
23 52 00	Boilers	ME-E	X							

SECTION NUMBER	SECTION TITLE	Author	ISSUE NUMBER							
			1	2	3	4	5	6	7	8
23 64 23	Air Cooled Scroll Heat Pump Water Chillers	ME-E	X							
23 73 13	Air Handling Units with Coil	ME-E	X							
23 73 24	Split System Dx Air Handling Units	ME-E	X							
23 81 23	Electronic Room Air Conditioning Unit	ME-E	X							
23 81 26	Split System Air Conditioners	ME-E	X							
23 81 29	Variable Refrigerant Flow HVAC Systems	ME-E	X							
23 82 16	Air Coils	ME-E	X							
23 82 19	Fan Coil Units	ME-E	X							
23 82 39	Heating Terminal Units	ME-E	X							
23 84 13	Humidifiers	ME-E	X							
23 90 00	Project Closeout	ME-E	X							
DIVISION 26 – ELECTRICAL *Refer To Alternates List For Applicable Sections										
26 05 00	Electrical Requirements	ME-E	X							
26 05 01*	Mechanical and Electrical Coordination 23 05 01 and 26 05 01	ME-E	X							
26 05 02	Basic Material and Methods	ME-E	X							
26 05 03	Manufacturers	ME-E	X							
26 05 10	Testing	ME-E	X							
26 05 19	Electrical Power Conductors and Cables	ME-E	X							
26 05 26	Grounding and Bonding	ME-E	X							
26 05 29	Hangers and Supports	ME-E	X							
26 05 33	Raceways and Boxes	ME-E	X							
26 05 43	Underground Ducts, Raceways and Manholes	ME-E	X							
26 05 48	Vibration and Seismic Controls	ME-E	X							

SECTION NUMBER	SECTION TITLE	Author	ISSUE NUMBER							
			1	2	3	4	5	6	7	8
26 05 53	Identification	ME-E	X							
26 05 73	Electrical Studies	ME-E	X							
26 09 13	Electrical Power Monitoring	ME-E	X							
26 09 36	Modular Dimming Controls	MCLA	X							
26 09 43	Lighting Control System	ME-E	X							
26 22 13	Low-Voltage Distribution Transformers	ME-E	X							
26 24 12	Utility Service Connection Cabinets	ME-E	X							
26 24 13	Distribution Switchboards	ME-E	X							
26 24 16	Panelboards	ME-E	X							
26 25 00	Enclosed Bus Assemblies	ME-E	X							
26 27 26	Wiring Devices	ME-E	X							
26 27 29	Electric Vehicle Charging Systems	ME-E	X							
26 28 16	Enclosed Switches, Fuses and Circuit Breakers	ME-E	X							
26 32 13	Diesel-Engine Driven Generator Sets	ME-E	X							
26 36 23	Automatic Transfer Switches	ME-E	X							
26 41 13	Lightning Protection for Structures	ME-E	X							
26 43 13	Surge Protective Device (SPD) (Selenium Enhanced)	ME-E	X							
26 43 14	Surge Protective Device (SPD)	ME-E	X							
26 51 00	Lighting Fixtures	MCLA	X							
26 56 13	Poles and Standards	ME-E	X							
26 90 00	Project Closeout	ME-E	X							
DIVISION 27 – COMMUNICATIONS										
27 05 00	Common Work Results for Communications	ME-E	X							
27 05 26	Telecommunications Grounding and Bonding	ME-E	X							

SECTION NUMBER	SECTION TITLE	Author	ISSUE NUMBER							
			1	2	3	4	5	6	7	8
27 05 33	Telecommunications Raceways and Boxes	ME-E	X							
27 05 36	Cable Trays	ME-E	X							
27 11 00	Communications Equipment Room Fit-Out	ME-E	X							
27 13 13	Communications Copper Backbone Cabling	ME-E	X							
27 13 23	Communications Optical Fiber Backbone Cabling	ME-E	X							
27 15 00	Communications Horizontal Cabling	ME-E	X							
27 41 00	Audio Visual Systems	ME-E	X							
27 53 20	Distributed Antenna Systems (DAS) General Requirements	ME-E	X							
DIVISION 28 – ELECTRONIC SAFETY AND SECURITY *Refer To Alternates List For Applicable Sections										
28 05 00.10	Common Work Results for Electronic Security	M2H	X							
28 05 09.10	Surge Protection for Electronic Security	M2H	X							
28 05 11	Cyber Security for Electronic Security	M2H	X							
28 05 13	Conductors and Cables for Electronic Security	M2H	X							
28 05 13.10	Servers, Workstations, and Storage for Electronic Security	M2H	X							
28 05 26.10	Grounding and Bonding for Electronic Security	M2H	X							
28 05 28.10	Pathways for Electronic Security	M2H	X							
28 05 29	Hangers and Supports for Communications Systems	M2H	X							
28 05 31.10	Communications Equipment for Electronic Security	M2H	X							
28 05 43	Underground Pathways for Elect Security	M2H	X							
28 05 44	Sleeves and Sleeve Seals for Electronic Security Pathways and Cabling	M2H	X							
28 08 00.10	Commissioning of Electronic Security	M2H	X							
28 11 16	Security Racks, Frames, and Enclosures	M2H	X							
28 13 00	Physical Access Control System	M2H	X							

SECTION NUMBER	SECTION TITLE	Author	ISSUE NUMBER							
			1	2	3	4	5	6	7	8
28 13 23	Optical Fiber Backbone Cabling for Electronic Security	M2H	X							
28 15 13	Security Copper Horizontal Cabling	M2H	X							
28 15 23	Intercom and Public Address Systems	M2H	X							
28 16 00	Intrusion Detection System	M2H	X							
28 23 00	Video Surveillance System	M2H	X							
28 46 00	Addressable Fire Alarm System	ME-E	X							
28 46 10*	Smoke Management 23 09 03 and 28 46 10	ME-E	X							
28 50 10	Area of Rescue Assistance System	ME-E	X							
28 50 20	Emergency Responder Radio System	ME-E	X							
28 51 00	Information Management & Presentation	M2H	X							
DIVISION 31 – EARTHWORK										
31 10 00	Site Clearing	AMT	X							
31 20 00	Earth Moving	AMT	X							
DIVISION 32 – EXTERIOR IMPROVEMENTS										
32 12 16	Asphalt Paving	AMT	X							
32 13 13	Concrete Paving	AMT	X							
32 13 13.33	Concrete Paving for Sidewalks	RHI	X							
32 13 73	Concrete Paving Joint Sealants	AMT	X							
32 13 73.33	Concrete Paving Joint Sealants for Sidewalks	RHI	X							
32 14 00	Unit Paving	FA	X							
32 17 13	Parking Bumpers	FA	X							
32 17 23	Pavement Markings	AMT	X							
32 17 26	Tactile Warning Surfacing	AMT	X							

SECTION NUMBER	SECTION TITLE	Author	ISSUE NUMBER							
			1	2	3	4	5	6	7	8
32 31 19	Decorative Metal Gates	FA	X							
32 91 15	Soil Preparation	RHI	X							
32 92 00	Lawns and Turfgrasses	RHI	X							
32 93 00	Exterior Plants	RHI	X							
32 96 00	Transplanting	RHI	X							
DIVISION 33 – UTILITIES										
33 14 15	Site Water Distribution Piping	AMT	X							
33 41 99	Stormwater Management	AMT	X							
33 42 00	Stormwater Conveyance	AMT	X							

END OF TABLE OF CONTENTS

DIVISION 00 - PROCUREMENT & CONTRACTING REQUIREMENTS

- Notice To Bidders - Solicitation Fact Sheet (eMaryland Marketplace Advantage attachment)
- Instructions to Bidders for Construction Projects (July 1, 2022) (eMaryland Marketplace Advantage attachment)
- General Conditions for Construction Contracts (July 1, 2022) (eMaryland Marketplace Advantage attachment)
- Bid/Proposal Affidavit (eMaryland Marketplace Advantage attachment)
- Payment of Employee Health Care Expenses Certification (eMaryland Marketplace Advantage attachment)
- Contractors Questionnaire (eMaryland Marketplace Advantage attachment)
- Bid Bond, *if applicable* (eMaryland Marketplace Advantage attachment)
- Minority Business Enterprise Forms Attachment D (February 5, 2021), *if applicable* (eMaryland Marketplace Advantage attachment)
- Veteran-owned Small Business Enterprise (VSBE) Forms Attachment E (September 1, 2022), *if applicable* (eMaryland Marketplace Advantage attachment)
- List of Prevailing Wage Rates, *if applicable* (eMaryland Marketplace Advantage attachment)
- Corporate Diversity Addendum, *if applicable* (eMaryland Marketplace attachment)
- Addenda*, if any* (eMaryland Marketplace Advantage attachment)
- List of Drawings (eMaryland Marketplace Advantage attachment)
- Attachment A – Contract (eMaryland Marketplace attachment)
- Pre-Bid Conference/Site Visit – **Refer to: State Finance and Procurement Article §14-302(a)(7)(v) and COMAR 21.11.03.09.C.(2)(e).**

This page is intentionally left blank.

SECTION 01 10 00 - SUMMARY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Project information.
2. Work covered by Contract Documents.
3. Work under Owner's separate contracts.
4. Owner-furnished/Owner-installed (OFOI) products.
5. Contractor's use of site and premises.
6. Work restrictions.
7. Specification and Drawing conventions.
8. Miscellaneous provisions.

B. Related Requirements:

1. Section 01 50 00 "Temporary Facilities and Controls" for limitations and procedures governing temporary use of Owner's facilities.
2. Section 01 50 10 "Temporary Facilities and Controls – State Field Office for Capitol Improvement Projects" for provision of field office for exclusive use by the State.
3. Section 02 41 19 “Selective Demolition” for contractor’s use of site, coordination with occupants, and work restrictions associated with the work of removal of historic courtroom at existing Supreme Court of Maryland building.
4. Section 01 73 00 "Execution" for coordination of Owner-installed products.

1.2 PROJECT INFORMATION

A. Project Identification: Supreme Court of Maryland, DGS Project No. BA-688-200-001, MDE No. 22-SF-0115.

1. Project Location: 101 Rowe Blvd, Annapolis, MD 21401.

B. Owner: State of Maryland.

1. Owner's Representative: State of Maryland Department of General Services (DGS), Design, Construction, & Energy Division, 301 West Preston Street, Room 1419B, Baltimore, MD 21201

C. Architect: Fentress Architects:

1. 1140 Connecticut Avenue NW, Suite 750, Washington, DC 20036.
2. Phone: (202) 337-5100.

D. Architect's Consultants: Architect has retained the following design professionals, who have prepared designated portions of the Contract Documents:

1. Associate Architect: ATI, Inc.

    a. 9220 Rumsey Road, Suite 100, Columbia, MD 21045.
    b. Phone: (410) 752-3720.

2. Civil Engineer: A. Morton Thomas (AMT).

    a. 800 King Farm Boulevard, 4th Floor, Rockville, MD 20850.
    b. Phone: (301) 806-7082.

3. Structural Engineer: Hope Furrer Associates (HFA).

    a. 501 Fairmount Avenue, Suite 205, Towson, MD 21286.
    b. Phone: (410) 583-4874.

4. Landscape Architect: Rhodeside & Harwell, Inc. (RHI).

    a. 510 King Street, 7447 300, Alexandria, VA 22314.
    b. Phone: (703) 683-4874.

5. Plumbing Engineer: WFT Engineering, Inc.

    a. 1801 Research Boulevard, Suite 100, Rockville, MD 20850.
    b. Phone: (301) 230-0811.

6. Mechanical, Fire Protection, Electrical, IT, Data, Telecommunication Engineer: ME Engineers.

    a. 14143 Denver West Parkway, Suite 300, Golden, CO 80401.
    b. Phone: (303) 421-6655.
    c. 1825 Market Center Boulevard, Suite 600, Dallas, TX 75207.
    d. Phone : (214) 741-1589.

7. Life Safety and Code Consultant: Jensen Hughes.

    a. 3610 Commerce Drive, suite 817. Baltimore, MD 21227.
    b. Phone: (410) 737-8677.

8. Lighting Designer: MCLA Architectural Lighting Design.

    a. 1000 Potomac Street NW, Suite 121, Washington, DC 20007.
    b. Phone: (202) 298-8062.

9. Geotechnical Engineer: Findling, Inc.

    a. 3401 Carlins Park Drive, Baltimore, MD 21215.
    b. Phone: (410) 367-1400.

10. Cost Estimating Consultant: OCMI.

    a. 6110 Executive Boulevard, Suite 200, Rockville, MD 20852.
    b. Phone: (202) 450-3843.

11. Security and Technology Engineer: M2H Protection, Consulting & Design.

    a. 14 West Main Street, Suite 2A, Middletown, MD 21769.
    b. Phone: (301) 371-6047.

E. Web-Based Project Software: Project software will be used for purposes of managing communication and documents during the construction stage.

1. See Section 01 31 00 "Project Management and Coordination." for requirements for using web-based Project software.

1.3 WORK COVERED BY CONTRACT DOCUMENTS

A. The Work of Project is defined by the Contract Documents and includes, but is not limited to, the following:

1. Construction of a new 5-story courthouse and other associated Work indicated in the Contract Documents.
2. Work also includes:

    a. Relocation, storage, restoration, and reuse of the Latrobe marble columns.
    b. Removal, protection, transportation, storage, restoration, and reinstallation of the Historic Courtroom currently located in the existing Supreme Court of Maryland building.

B. Type of Contract:

1. Project will be constructed under a single prime general construction contract.

1.4 WORK UNDER OWNER'S SEPARATE CONTRACTS

A. Work with Separate Contractors: Cooperate fully with Owner's separate contractors, so work on those contracts may be carried out smoothly, without interfering with or delaying Work under this Contract or other contracts. Coordinate the Work of this Contract with work performed under Owner's separate contracts.

B. Work provided under Owner’s separate contracts includes the following:

1. Workstation and Systems Furnishings.
2. Courtsmart Courtroom Technology System.

1.5 OWNER-FURNISHED/OWNER-INSTALLED (OFOI) PRODUCTS

A. Owner-Furnished/Owner-Installed (OFOI) Products:

1. Furniture.
2. Office Equipment.
3. Workstations/Systems Furniture.
4. Magnometer.
5. Security Scanner.

1.6 CONTRACTOR'S USE OF SITE AND PREMISES

A. Unrestricted Use of Site: Contractor shall have full use of Project site for construction operations during construction period. Contractor's use of Project site is limited only by Owner's right to perform work or to retain other contractors on portions of Project.

B. Limits on Use of Site: Limit use of Project site to Work in areas indicated. Do not disturb portions of Project site beyond areas in which the Work is indicated.

1. Driveways, Walkways and Entrances: Keep driveways, loading areas, and entrances serving adjacent properties clear and available at all times. Do not use these areas for parking or for storage of materials.

a. Schedule deliveries to minimize use of driveways and entrances by construction operations.
b. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.

C. Condition of Existing Grounds: Maintain portions of existing adjacent grounds, landscaping, and hardscaping affected by construction operations throughout construction period. Repair damage caused by construction operations.

D. Traffic Control: Coordinate lane closures of perimeter streets with City of Annapolis. Obtain necessary permits as required.

1. All traffic control must be in accordance with the current edition of the Maryland M.U.T.C.D., the Maryland S.H.A. work zone traffic control standards and details, and the City of Annapolis work zone traffic control standards and details. It is the responsibility of the Contractor to supply, install, and maintain all traffic control equipment for the duration of this contract.
2. Maintain a minimum four (4) foot wide pedestrian footway or implement an appropriate pedestrian detour approved by DOT-Traffic, while actively working in the sidewalk.
3. Contact the Department of Transportation Staff (443-984-2150) two (2) weeks prior to the start of construction and one (1) week prior to any changes to the Maintenance of Traffic (M.O.T.) plan.
4. Perform no work or disruptions to traffic between the hours of 6:00 a.m. 9:00 a.m. and 3:00 p.m. 6:00 p.m. on weekdays. The Contractor must get approval from the Department of Transportation in writing for any work on Holidays or weekends.
5. The Contractor shall notify the Baltimore Transportation Management Center at (443) 984-2189 and TMC.DOT@baltimorecity.gov when implementing any lane closures, roadway closures, or detours as indicated in an approved traffic control plan.
6. The contractor is responsible for installation of any temporary NO STOPPING prohibition signing that will be necessary to complete this project. A minimum of seventy-two (72) hours' notice is required for any temporary parking restrictions.
7. The Contractor shall coordinate with MTA for work that may impact transit operations.

1.7 WORK RESTRICTIONS

A. Comply with restrictions on construction operations.

1. Comply with limitations on use of public streets, work on public streets, rights of way, and other requirements of authorities having jurisdiction.

B. On-Site Work Hours: Limit work to between 7:00 a.m. to 7:00 p.m., Monday through Friday, unless otherwise indicated. Work hours may be modified to meet Project requirements if approved by Owner and authorities having jurisdiction.

1. Weekend Hours: 7:00 a.m. to 7:00 p.m. with pre-approval, which must be requested and approved 2 full business days in advance.

C. Noise, Vibration, Dust, and Odors: Conduct all work in accordance with City of Annapolis ordinances. Coordinate operations that may result in high levels of noise and vibration, dust, odors, or other disruption to adjacent buildings with Owner.

1. Notify Owner not less than two days in advance of proposed disruptive operations.
2. Obtain Owner's written permission before proceeding with disruptive operations.

D. Smoking and Controlled Substance Restrictions: Use of tobacco products, alcoholic beverages, and other controlled substances on Project site is not permitted.

E. Employee Identification: Provide identification tags for Contractor personnel working on Project site. Require personnel to use identification tags at all times.

F. Employee Screening: Comply with Owner's requirements for drug and criminal background screening of Contractor personnel working on Project site.

1. Maintain list of approved screened personnel with Owner's representative.

1.8 SPECIFICATION AND DRAWING CONVENTIONS

A. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:

1. Imperative mood and streamlined language are generally used in the Specifications. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.
2. Text Color: Text used in the Specifications, including units of measure, manufacturer and product names, and other text may appear in multiple colors or underlined as part of a hyperlink; no emphasis is implied by text with these characteristics.
3. Hypertext: Text used in the Specifications may contain hyperlinks. Hyperlinks may allow for access to linked information that is not residing in the Specifications. Unless otherwise indicated, linked information is not part of the Contract Documents.
4. Specification requirements are to be performed by Contractor unless specifically stated otherwise.

B. Division 00 Contracting Requirements: General provisions of the Contract, including General and Supplementary Conditions, apply to all Sections of the Specifications.

C. Division 01 General Requirements: Requirements of Sections in Division 01 apply to the Work of all Sections in the Specifications.

D. Drawing Coordination: Requirements for materials and products identified on Drawings are described in detail in the Specifications. One or more of the following are used on Drawings to identify materials and products:

1. Terminology: Materials and products are identified by the typical generic terms used in the individual Specifications Sections.
2. Abbreviations: Materials and products are identified by abbreviations scheduled on Drawings and published as part of the U.S. National CAD Standard.
3. Keynoting: Materials and products may be identified by reference keynotes referencing Specification Section numbers found in this Project Manual.

1.9 MISCELLANEOUS PROVISIONS

A. Contractor Project Team Qualifications:

1. Prior to final selection of Contractor and award of Contract, provide the following qualification information and resumes of key personnel proposed for the Project. Resumes and prior project experience must demonstrate that the proposed personnel for assignment to this Project are experienced in projects of similar scope, budget, and complexity including, but not limited to, LEED sustainability requirements.

    a. Contractor's Experience: Work on three projects of comparable size and complexity in the last 5 years.
    b. Project Manager: To be office-based and assigned full time to this project, and with demonstrated experience (min 3 projects) with high rise construction over 200,000 GSF and a minimum of one courthouse or secure government office facility.
    c. Senior Superintendent: To be based on-site, assigned to and present on-site full time, and with demonstrated experience (minimum 3 projects) with high rise construction over 200,000 GSF and a minimum of one courthouse or secure government office facility.
    d. Assistant Superintendents: To be based on-site, assigned to and present on-site full time for the duration of the work they are responsible for overseeing, and with demonstrated experience (minimum 1 project) with high rise construction over 200,000 GSF or one courthouse or one secure government office facility.
    e. Provide a project Owner or Architect reference and contact information for all projects indicated in items above.
    f. Indicate the primary company and person responsible for restoration, relocation, and reinstallation of historic marble columns and historic Supreme Courtroom with demonstrated subject matter experience and expertise.

2. The Owner shall have the right, at their sole discretion, to require the Contractor to dismiss from the project any project team member with personnel satisfactory to the Owner, at no additional cost.
3. Contractor shall not replace any project team member without the consent of the Owner, except with personnel satisfactory to the Owner in all respects.
4. Superintendents identified for special portions of the building shall not be used as skilled or unskilled labor and shall be on site full time during the duration of the work they are responsible for overseeing.

B. Electronic Drawing Files

1. Refer to Section 01 31 00 "Project Management and Coordination" for the use of and requirements to obtain Architect's and Architect's Consultants electronic drawing files.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

This page is intentionally left blank.

SECTION 01 21 00 - ALLOWANCES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements governing allowances.

B. Types of allowances include the following:

1. Lump-sum allowances.

C. Related Requirements:

1. Section 01 22 00 "Unit Prices" for procedures for using unit prices, including adjustment of quantity allowances when applicable.
2. Section 01 26 00 "Contract Modification Procedures" for procedures for submitting and handling Change Orders.

1.2 DEFINITIONS

A. Allowance: A quantity of work or dollar amount included in the Contract, established in lieu of additional requirements, used to defer selection of actual materials and equipment to a later date when direction will be provided to Contractor. If necessary, additional requirements will be issued by Change Order.

1.3 SELECTION AND PURCHASE

A. At the earliest practical date after award of the Contract, advise Architect of the date when final selection, or purchase and delivery, of each product or system described by an allowance must be completed by the Owner to avoid delaying the Work.

B. At Architect's request, obtain proposals for each allowance for use in making final selections. Include recommendations that are relevant to performing the Work.

C. Purchase products and systems selected by Architect from the designated supplier.

1.4 ACTION SUBMITTALS

A. Submit proposals for purchase of products or systems included in allowances in the form specified for Change Orders.

1.5 INFORMATIONAL SUBMITTALS

A. Submit invoices or delivery slips to show actual quantities of materials delivered to the site for use in fulfillment of each allowance.

B. Submit time sheets and other documentation to show labor time and cost for installation of allowance items that include installation as part of the allowance.

C. Coordinate and process submittals for allowance items in same manner as for other portions of the Work.

1.6 LUMP-SUM ALLOWANCES

A. Allowance shall include cost to Contractor of specific products and materials selected by Owner or Architect under allowance and shall include taxes, freight, and delivery to Project site.

B. Unless otherwise indicated, Contractor's costs for receiving and handling at Project site, labor, installation, overhead and profit, and similar costs related to products and materials ordered by Owner or selected by Architect under allowance shall be included as part of the Contract Sum and not part of the allowance.

1.7 ADJUSTMENT OF ALLOWANCES

A. Allowance Adjustment: To adjust allowance amounts, prepare a Change Order proposal based on the difference between purchase amount and the allowance, multiplied by final measurement of work-in-place where applicable. If applicable, include reasonable allowances for cutting losses, tolerances, mixing wastes, normal product imperfections, required maintenance materials, and similar margins.

1. Include installation costs in purchase amount only where indicated as part of the allowance.
2. If requested, prepare explanation and documentation to substantiate distribution of overhead costs and other markups.
3. Owner reserves the right to establish the quantity of work-in-place by independent quantity survey, measure, or count.

B. Submit claims for increased costs due to a change in the scope or nature of the allowance described in the Contract Documents, whether for the purchase order amount or Contractor's handling, labor, installation, overhead, and profit.

1. Do not include Contractor's or subcontractor's indirect expense in the Change Order cost amount unless it is clearly shown that the nature or extent of Work has changed from what could have been foreseen from information in the Contract Documents.
2. No change to Contractor's indirect expense is permitted for selection of higher- or lower-priced materials or systems of the same scope and nature as originally indicated.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine products covered by an allowance promptly on delivery for damage or defects. Return damaged or defective products to manufacturer for replacement.

3.2 PREPARATION

A. Coordinate materials and their installation for each allowance with related materials and installations to ensure that each allowance item is completely integrated and interfaced with related work.

3.3 SCHEDULE OF ALLOWANCES

A. Allowance No. 1 **-** Carpet: $500,000.00.

1. In accordance with Section 09 68 13, include the sum of $500,000.00 for purchase, storage, delivery, handling, and installation of carpet materials as selected by the Owner/Architect

B. Allowance No. 2 - Building Signage: $150,000.00.

1. Include the sum of $150,000.00 for purchase, storage, delivery, handling, installation of interior and exterior building signage as selected by the Owner/Architect.

C. Allowance No. 3 - Utility Connection Fees: $200,000.00.

1. Include the sum of $200,000.00 for all utility, permit, connection fees, and inspections.

D. Allowance No. 4 - Building Security Systems Devices & Equipment: $500,000.00.

1. Include the stipulated sum of $500,000.00 for **additional** building security devices, hardware, and systems, installation, and programming not included in the Base Bid scope of the Bid Documents.
2. The Contractor is responsible under the Base Bid to provide fully functional systems for all work shown on the Security drawings. This shall include all hardware, cabling, conduits, connections under the base contract.
3. The Prime Contractor, under the base bid, is responsible for providing all software, custom programming, configuration, and integration as required for a fully functional system.
4. This allowance will be used at the discretion of the Owner for additional security scope not included in the Contract Documents.

E. Allowance No. 5 - High Density Filing System: $500,000.00.

1. Include the sum of $500,000.00 for purchase, delivery and installation of Manual High Density Filing Systems as selected by the Owner/Architect.

F. Allowance No. 6 - Decorative Light Fixtures: $300,000.00.

1. Include the sum of $300,000.00 for purchase, delivery, and installation of decorative light fixture in the Ceremonial Stairway as selected by the Owner/Architect.

G. Allowance No. 7 – For the “Fit-up” of the Maryland Law Museum on the second floor of the courthouse: $2,200,000.00.

1. Include the sum of $2,200,000.00 for “Fit-up” or finishing of the empty space as shown in plan on the second floor of the courthouse into a Law Museum for the State of Maryland Judiciary.

H. Allowance No. 8 – Bronze Dedication Plaque: $10,000.00.

1. Include the sum of $10,000.00 for purchase, delivery, and installation of decorative bronze dedication plaque as selected by the Owner/Architect.

I. Allowance No. 9 – Repair of the Historic Clock in the Historic Courtroom: $10,000.00.

1. Include the sum of $10,000.00 for removal from the Murphy Courthouse, delivery to an acknowledged historical clock restoration expert, restorations of said clock, delivery back to the project and installation up onto the wall of the newly restored and relocated Historic Courtroom in the new courthouse. Selection of clock restoration expert must be approved by Owner/Architect in advance of all work.

J. Allowance No.10 – Removal of the Brick “Welcome to Annapolis” advertising wall/sign on the corner of Rowe Boulevard and Farragut: $6,000.00.

1. Include the sum of $6,000.00 for removal from the corner of Rowe Boulevard and Farragut the “Welcome to Annapolis” advertising wall/sign. Repair the sidewalk and/or lawn area as required to finish the site work.

K. Allowance No. 11 – Custom Elevator Cabs and Entrance Doors: $600,000.00

1. Include the sum of $600,000.00 for custom elevator cabs and entrance doors at EL-01, EL-02, and EL-03. This allowance includes material cost receiving, handling, and installation and Contractor overhead and profit.

END OF SECTION

SECTION 01 22 00 - UNIT PRICES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for unit prices.

B. Related Requirements:

1. Section 01 21 00 "Allowances" for procedures for using unit prices to adjust quantity allowances.
2. Section 01 26 00 “Contract Modification Procedures” for procedures for submitting and handling Change Orders.

1.2 DEFINITIONS

A. Unit price is an amount incorporated into the Agreement, applicable during the duration of the Work as a price per unit of measurement for materials, equipment, or services, or a portion of the Work, added to or deducted from the Contract Sum by appropriate modification, if the scope of Work or estimated quantities of Work required by the Contract Documents are increased or decreased.

1.3 PROCEDURES

A. Unit prices include all necessary material, plus cost for delivery, installation, insurance, applicable taxes, overhead, and profit.

B. Owner reserves the right to reject Contractor's measurement of work-in-place that involves use of established unit prices and to have this work measured, by an independent surveyor acceptable to Contractor.

C. List of Unit Prices: A schedule of unit prices is included in Part 3. Refer to applicable technical specification sections for products described in each unit price.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 SCHEDULE OF UNIT PRICES

A. Unit Price No. 1 – Unsuitable Soil: Removal of unsatisfactory soil and replacement with satisfactory soil material.

1. Description: Unsatisfactory soil excavation, legal disposal off-site and replacement with satisfactory soil material or engineered fill from off-site, as required, in accordance with Section 312000 "Earth Moving."
2. Unit of Measurement: One (1) cubic yard (cu. yd) of soil excavated, based on in-place surveys of volume before and after removal.
3. Quantity Allowance: 100 Cubic Yards.

B. Unit Price No. 2: Contaminated Soil - Removal of contaminated soils and replacement with satisfactory soil material.

1. Description: Contaminated soil excavation, legal disposal off-site and replacement with satisfactory soil material or engineered fill from off-site, as required, in accordance with Section 312000 "Earth Moving."
2. Unit of Measurement: One (1) cubic yard (cu. yd) of soil excavated, based on in-place surveys of volume before and after removal.
3. Quantity Allowance: 100 Cubic Yards.

C. Unit Price No. 3: Flowable Fill

1. Description: Placement of Flowable Fill material in accordance with Section 31 20 00 "Earth Moving."
2. Unit of Measurement: One (1) cubic yard (cu. yd) of material placed, based on in-place surveys of volume before and after removal.
3. Quantity Allowance: 100 Cubic Yards.

D. Unit Price No. 4: Select Fill

1. Description: Placement of 4,000 psi material in accordance with Section 03 30 00 "Cast-In-Place Concrete."
2. Unit of Measurement: One (1) cubic yard (cu. yd) of material placed, based on in-place surveys of volume before and after removal.
3. Quantity Allowance: 100 Cubic Yards.

E. Unit Price No. 5: Soil Cement - Lean Concrete Fill

1. Description: Placement of 4,000 psi material in accordance with Section 03 30 00 "Cast-In-Place Concrete."
2. Unit of Measurement: One (1) cubic yard (cu. yd) of material placed, based on in-place surveys of volume before and after removal.
3. Quantity Allowance: 100 Cubic Yards.

F. Unit Price No. 6 – Ceiling Mounted Exit Signs:

1. Description: Ceiling mounted exits signs as specified in technical specification sections for exit signs in addition to those shown on the Drawings that may be required by the authority-having-jurisdiction.
2. Unit of Measurement: One (1) each.

G. Unit Price No. 7 – Wall Mounted Exit Signs:

1. Description: Wall mounted exits signs as specified in technical specification sections for exit signs in addition to those shown on the Drawings that may be required by the authority-having-jurisdiction.

2. Unit of Measurement: One (1) each.

H. Unit Price No. 8 – Ceiling mounted fire alarm strobes:

1. Description: Ceiling mounted fire alarm strobes as specified in technical specification sections for ceiling mounted fire alarm strobes in addition to those shown on the Drawings that may be required by the authority-having-jurisdiction.
2. Unit of Measurement: One (1) each.

I. Unit Price No. 9 – Wall mounted fire alarm strobes:

1. Description: Wall mounted fire alarm strobes as specified in technical specification sections for wall mounted fire alarm strobes in addition to those shown on the Drawings that may be required by the authority-having-jurisdiction.
2. Unit of Measurement: One (1) each.

J. Unit Price No. 10 – Ceiling mounted fire alarm speaker/strobes:

1. Description: Ceiling mounted fire alarm speaker/strobes as specified in technical specification sections for ceiling mounted fire alarm speaker/strobes in addition to those shown on the Drawings that may be required by the authority-having-jurisdiction.
2. Unit of Measurement: One (1) each.

K. Unit Price No. 11 – Wall mounted fire alarm speaker/strobes:

1. Description: Wall mounted fire alarm strobes as specified in technical specification sections for wall mounted fire alarm speaker/strobes in addition to those shown on the Drawings that may be required by the authority-having-jurisdiction.
2. Unit of Measurement: One (1) each.

L. Unit Price No. 12 – Concealed fire sprinkler heads:

1. Description: Concealed type fire sprinkler head including all supply piping required as may be added by Architect for aesthetic effect during review of delegated design fire sprinkler Shop Drawings and not already indicated on Drawings. Fire sprinkler heads not shown on Drawings and added by delegated design fire sprinkler contractor in order to comply with Performance Requirements are included in base bid and not covered by this unit price.
2. Unit of Measurement: One (1) each.

M. Unit Price No. 13 – Bronze Seals:

1. Description: Unit price for additional 30-inch-diameter bronze seals as specified in Section 10 14 00 “Signage” in excess of those shown on the Drawings. The cost of the bronze seals indicated on the Drawings shall be included in the Base Bid.
2. Unit of Measurement: One (1) each.

END OF SECTION

This page is intentionally left blank.

SECTION 01 23 00 - ALTERNATES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for alternates.

1.2 DEFINITIONS

A. Alternate: An amount proposed by bidders and stated on the Bid Form for certain work defined in the bidding requirements that may be added to or deducted from the base bid amount if the Owner decides to accept a corresponding change either in the amount of construction to be completed or in the products, materials, equipment, systems, or installation methods described in the Contract Documents.

1. Alternates described in this Section are part of the Work only if enumerated in the Agreement.
2. The cost or credit for each alternate is the net addition to or deduction from the Contract Sum to incorporate alternates into the Work. No other adjustments are made to the Contract Sum.

1.3 PROCEDURES

A. Coordination: Revise or adjust affected adjacent work as necessary to completely integrate work of the alternate into Project.

1. Include, as part of each alternate, miscellaneous devices, accessory objects, and similar items incidental to or required for a complete installation, whether or not indicated as part of alternate.

B. Execute accepted alternates under the same conditions as other Work of the Contract.

C. Schedule: A Part 3 "Schedule of Alternates" Article is included at the end of this Section. Specification Sections referenced in schedule contain requirements for materials necessary to achieve the work described under each alternate.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 SCHEDULE OF ALTERNATES

A. Alternate No. 1: Ballistic Window Glazing, Frames, and Doors.

1. Base Bid: Provide Level 4 ballistic resistance in accordance with UL 752 where ballistic glazing, frames, and doors are indicated on Drawings and as specified in Section 08 56 53 "Security Windows" and Section 08 88 53 "Security Glazing"
2. Alternate: Provide Level 3 ballistic resistance in accordance with UL 752 where ballistic glazing, frames, and doors are indicated on Drawings and as where specified as Level 4 in Section 08 56 53 "Security Windows" and Section 08 88 53 "Security Glazing"

B. Alternate No. 2: Wood Flooring at Judge's Chambers.

1. Base Bid: Provide engineered wood flooring Type WF-1 as specified in the Material Schedule in locations indicated on Drawings.
2. Alternate: Provide engineered wood flooring Type WF-1a as specified in the Material Schedule in locations indicated to receive WF-1 on Drawings.

END OF SECTION

SECTION 01 25 00 - SUBSTITUTION PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for substitutions.

B. Related Requirements:

1. Section 01 60 00 "Product Requirements" for requirements for submitting comparable product submittals for products by listed manufacturers.

1.2 DEFINITIONS

A. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents.

1. Substitutions for Cause: Changes proposed by Contractor that are required due to changed Project conditions, such as unavailability of product, regulatory changes, or unavailability of required warranty terms.
2. Substitutions for Convenience: Changes proposed by Contractor that are not required to meet other Project requirements but may offer advantage to Contractor or Owner.

1.3 ACTION SUBMITTALS

A. Substitution Requests: Submit documentation identifying product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.

1. Substitution Request Form: Use form acceptable to Architect.
2. Documentation: Show compliance with requirements for substitutions and the following, as applicable:

a. Statement indicating why specified product or fabrication or installation method cannot be provided, if applicable.
b. Coordination of information, including a list of changes or revisions needed to other parts of the Work and to construction performed by Owner and separate contractors that will be necessary to accommodate proposed substitution.
c. Detailed comparison of significant qualities of proposed substitutions with those of the Work specified. Include annotated copy of applicable Specification Section. Significant qualities may include attributes, such as performance, weight, size, durability, visual effect, sustainable design characteristics, warranties, and specific features and requirements indicated. Indicate deviations, if any, from the Work specified.
d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
e. Samples, where applicable or requested.

f. Certificates and qualification data, where applicable or requested.
g. List of similar installations for completed projects, with project names and addresses as well as names and addresses of architects and owners.
h. Material test reports from a qualified testing agency, indicating and interpreting test results for compliance with requirements indicated.
i. Research reports evidencing compliance with building code in effect for Project, from ICC-ES.
j. Detailed comparison of Contractor's construction schedule using proposed substitutions with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating date of receipt of purchase order, lack of availability, or delays in delivery.
k. Cost information, including a proposal of change, if any, in the Contract Sum.
l. Contractor's certification that proposed substitution complies with requirements in the Contract Documents, except as indicated in substitution request, is compatible with related materials and is appropriate for applications indicated.
m. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.

3. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within 14 days of receipt of a request for substitution. Architect will notify Contractor of acceptance or rejection of proposed substitution within 14 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.

a. Forms of Acceptance: Change Order, Construction Change Directive, or Architect's Supplemental Instructions for minor changes in the Work.
b. Use product specified if Architect does not issue a decision on use of a proposed substitution within time allocated.

1.4 QUALITY ASSURANCE

A. Compatibility of Substitutions: Investigate and document compatibility of proposed substitution with related products and materials. Engage a qualified testing agency to perform compatibility tests recommended by manufacturers.

1.5 PROCEDURES

A. Coordination: Revise or adjust affected work as necessary to integrate work of the approved substitutions.

1.6 SUBSTITUTIONS

A. Substitutions for Cause: Submit requests for substitution immediately on discovery of need for change, but not later than 28 days prior to time required for preparation and review of related submittals.

1. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:

    a. Requested substitution is consistent with the Contract Documents and will produce indicated results.
    b. Substitution request is fully documented and properly submitted.
    c. Requested substitution will not adversely affect Contractor's construction schedule.
    d. Requested substitution has received necessary approvals of authorities having jurisdiction.
    e. Requested substitution is compatible with other portions of the Work.
    f. Requested substitution has been coordinated with other portions of the Work.
    g. Requested substitution provides specified warranty.
    h. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.

B. Substitutions for Convenience: Substitutions for convenience may be considered or rejected at discretion of Architect.

1. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:

    a. Requested substitution offers Owner a substantial advantage in cost, time, energy conservation, or other considerations, after deducting additional responsibilities Owner must assume. Owner's additional responsibilities may include compensation to Architect for redesign and evaluation services, increased cost of other construction by Owner, and similar considerations.
    b. Requested substitution does not require extensive revisions to the Contract Documents.
    c. Requested substitution is consistent with the Contract Documents and will produce indicated results.
    d. Substitution request is fully documented and properly submitted.
    e. Requested substitution will not adversely affect Contractor's construction schedule.
    f. Requested substitution has received necessary approvals of authorities having jurisdiction.
    g. Requested substitution is compatible with other portions of the Work.
    h. Requested substitution has been coordinated with other portions of the Work.
    i. Requested substitution provides specified warranty.
    j. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

This page is intentionally left blank.

SECTION 01 26 00 - CONTRACT MODIFICATION PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for handling and processing Contract modifications.

B. Related Requirements:

1. DGS General Conditions of the Contract for administrative requirements for using unit prices.
2. Section 01 25 00 "Substitution Procedures" for administrative procedures for handling requests for substitutions made after the Contract award.
3. Section 01 31 00 "Project Management and Coordination" for requirements for forms for contract modifications provided as part of web-based Project management software.

1.2 MINOR CHANGES IN THE WORK

A. Architect will issue supplemental instructions authorizing minor changes in the Work, not involving adjustment to the Contract Sum or the Contract Time, on AIA Document G710 (Architect's Supplemental Instructions) via web-based Project management software.

1.3 PROPOSAL REQUESTS

A. Owner-Initiated Proposal Requests: Architect will issue a detailed description of proposed changes in the Work that may require adjustment to the Contract Sum or the Contract Time. If necessary, the description will include supplemental or revised Drawings and Specifications.

1. Work Change Proposal Requests issued by Architect are not instructions either to stop work in progress or to execute the proposed change.
2. Within time specified in Proposal Request or 21 calendar days, when not otherwise specified, after receipt of Proposal Request, submit a quotation estimating cost adjustments to the Contract Sum and the Contract Time necessary to execute the change.

    a. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
    b. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
    c. Include costs of labor and supervision directly attributable to the change.
    d. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.

e. Quotation Form: Use forms acceptable to Architect or form provided as part of web-based Project management software.

B. Contractor-Initiated Proposals: If latent or changed conditions require modifications to the Contract, Contractor may initiate a claim by submitting a request for a change to Architect.

1. Include a statement outlining reasons for the change and the effect of the change on the Work. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and the Contract Time.
2. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
3. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
4. Include costs of labor and supervision directly attributable to the change.
5. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
6. Comply with requirements in DGS General Conditions and Section 01 25 00 "Substitution Procedures" if the proposed change requires substitution of one product or system for product or system specified.
7. Proposal Request Form: Use form acceptable to Architect or form provided as part of web-based Project management software.

1.4 ADMINISTRATIVE CHANGE ORDERS

A. Allowance Adjustment: See Section 01 21 00 "Allowances" for administrative procedures for preparation of Change Order Proposal for adjusting the Contract Sum to reflect actual costs of allowances.

B. Unit-Price Adjustment: See Section 01 22 00 "Unit Prices" for administrative procedures for preparation of Change Order Proposal for adjusting the Contract Sum to reflect measured scope of unit-price work.

1.5 CHANGE ORDER PROCEDURES

A. On Owner's approval of a Work Change Proposal Request, Architect will issue a Change Order for signatures of Owner and Contractor on DGS formatted Change Order Form.

1.6 CONSTRUCTION CHANGE DIRECTIVE

A. Construction Change Directive: Architect may issue a Construction Change Directive on AIA Document G714. Construction Change Directive instructs Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.

1. Construction Change Directive contains a complete description of change in the Work. It also designates method to be followed to determine change in the Contract Sum or the Contract Time.

B. Documentation: Maintain detailed records of work required by the Construction Change Directive in accordance with applicable provisions of DGS General Conditions.

1. After completion of change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

This page is intentionally left blank.

SECTION 01 29 00 - PAYMENT PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements necessary to prepare and process Applications for Payment.

B. Related Requirements:

1. Section 01 21 00 "Allowances" for procedural requirements governing the handling and processing of allowances.
2. Section 01 22 00 "Unit Prices" for administrative requirements governing the use of unit prices.
3. Section 01 26 00 "Contract Modification Procedures" for administrative procedures for handling changes to the Contract.
4. Section 01 32 00 "Construction Progress Documentation" for administrative requirements governing the preparation and submittal of the Contractor's construction schedule.

1.2 DEFINITIONS

A. Schedule of Values: A statement furnished by Contractor allocating portions of the Contract Sum to various portions of the Work and used as the basis for reviewing Contractor's Applications for Payment.

1.3 SCHEDULE OF VALUES

A. Coordination: Coordinate preparation of the Schedule of Values with preparation of Contractor's Construction Schedule. Cost-loaded Critical Path Method (CPM) Schedule may serve to satisfy requirements for the Schedule of Values.

1. Coordinate line items in the Schedule of Values with items required to be indicated as separate activities in Contractor's construction schedule.
2. Submit the Schedule of Values to Architect at earliest possible date, but no later than fourteen (14) calendar days before the date scheduled for submittal of initial Applications for Payment.
3. Subschedules for Phased Work: Where the Work is separated into phases requiring separately phased payments, provide subschedules showing values coordinated with each phase of payment.
4. Subschedules for Separate Elements of Work: Where the Contractor's construction schedule defines separate elements of the Work, provide subschedules showing values coordinated with each element.

B. Format and Content: Use Project Manual table of contents as a guide to establish line items for the Schedule of Values. Provide at least one line item for each Specification Section.

1. Identification: Include the following Project identification on the Schedule of Values:

a. Project name and location.
b. Owner's name.
c. DGS Project Number.
d. Name of Architect.
e. Architect's Project number.
f. Contractor's name and address.
g. Date of submittal.

2. Arrange schedule of values consistent with format of AIA Document G703.
3. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Provide multiple line items for principal subcontract amounts in excess of five percent of the Contract Sum.
4. Provide a separate line item in the schedule of values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed.

    a. Differentiate between items stored on-site and items stored off-site.

5. Allowances: Provide a separate line item in the schedule of values for each allowance. Show line-item value of unit-cost allowances, as a product of the unit cost, multiplied by measured quantity. Use information indicated in the Contract Documents to determine quantities.
6. Purchase Contracts: Provide a separate line item in the schedule of values for each Purchase contract. Show line-item value of Purchase contract. Indicate Owner payments or deposits, if any, and balance to be paid by Contractor.
7. Overhead Costs, Proportional Distribution: Include total cost and proportionate share of general overhead and profit for each line item.
8. Overhead Costs, Separate Line Items: Show cost of temporary facilities and other major cost items that are not direct cost of actual work-in-place as separate line items.
9. Temporary Facilities: Show cost of temporary facilities and other major cost items that are not direct cost of actual work-in-place as separate line items.
10. Closeout Costs. Include separate line items under Contractor and principal subcontracts for Project closeout requirements in an amount totaling five percent of the Contract Sum and subcontract amount.
11. Schedule of Values Revisions: Revise the schedule of values when Change Orders or Construction Change Directives result in a change in the Contract Sum. Include at least one separate line item for each Change Order and Construction Change Directive.
12. Schedule Updating: Update and resubmit the Schedule of Values before the next Applications for Payment when Change Orders or Construction Change Directives result in a change in the Contract Sum.

1.4 APPLICATIONS FOR PAYMENT

A. Each Application for Payment shall be consistent with previous applications and payments, as certified by Architect and paid for by Owner.

B. Payment Application Submittal Date: The date for each progress payment is indicated in the Agreement between Owner and Contractor. The period of construction Work covered by each Application for Payment is the period indicated in the Agreement.

C. Payment Application Times: Progress payments shall be submitted to the Architect and DGS Construction no later than the 25th day of the month. The period covered by each Application for Payment is one month, ending on the last day of the month.

1. Submit draft copy of Application for Payment seven days prior to due date for review by Architect.

D. Application for Payment Forms: As indicated in DGS General Conditions.

E. Application Preparation: Complete every entry on form. Notarize and execute by a person authorized to sign legal documents on behalf of Contractor. Architect will return incomplete applications without action.

1. Entries shall match data on the schedule of values and Contractor's construction schedule. Use updated schedules if revisions were made.
2. Include amounts for work completed following previous Application for Payment, whether or not payment has been received. Include only amounts for work completed at time of Application for Payment.
3. Include amounts of Change Orders and Construction Change Directives issued before last day of construction period covered by application.
4. Indicate separate amounts for work being carried out under Owner-requested project acceleration.

F. Stored Materials: Include in Application for Payment amounts applied for materials or equipment purchased or fabricated and stored, but not yet installed. Differentiate between items stored on-site and items stored off-site.

1. Provide certificate of insurance, evidence of transfer of title to Owner, and consent of surety to payment for stored materials.
2. Provide supporting documentation that verifies amount requested, such as paid invoices. Match amount requested with amounts indicated on documentation; do not include overhead and profit on stored materials.
3. Provide summary documentation for stored materials indicating the following:

    a. Value of materials previously stored and remaining stored as of date of previous Applications for Payment.
    b. Value of previously stored materials put in place after date of previous Application for Payment and on or before date of current Application for Payment.
    c. Value of materials stored since date of previous Application for Payment and remaining stored as of date of current Application for Payment.

G. Transmittal: Submit digital (pdf) signed and notarized copy of Application for Payment to Architect by a method ensuring receipt.

1. Transmit each copy with a transmittal form listing attachments and recording appropriate information about application.

H. Waivers of Mechanic's Lien: With each Application for Payment, submit waivers of mechanic's lien from every entity who is lawfully entitled to file a mechanic's lien arising out of the Contract and related to the Work covered by the payment.

1. Submit partial waivers on each item for amount requested in previous application, after deduction for retainage, on each item.

2. When an application shows completion of an item, submit conditional final or full waivers.
3. Owner reserves the right to designate which entities involved in the Work must submit waivers.
4. Submit final Application for Payment with or preceded by conditional final waivers from every entity involved with performance of the Work covered by the application who is lawfully entitled to a lien.
5. Waiver Forms: Submit executed waivers of lien on forms acceptable to Owner.

I. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of first Application for Payment include the following:

1. List of subcontractors.
2. Schedule of Values.
3. Contractor's Construction Schedule (preliminary if not final).
4. Products list (preliminary if not final).
5. Sustainable design action plans, including preliminary project materials cost data.
6. Schedule of unit prices.
7. Submittal schedule (preliminary if not final).
8. List of Contractor's staff assignments.
9. List of Contractor's principal consultants.
10. Initial progress report.
11. Report of preconstruction conference.
12. Certificates of insurance and insurance policies.
13. Performance and payment bonds.
14. Data needed to acquire Owner's insurance.

J. Application for Payment at Substantial Completion: After Architect issues the Certificate of Substantial Completion, submit an Application for Payment showing 100 percent completion for portion of the Work claimed as substantially complete.

1. Include documentation supporting claim that the Work is substantially complete and a statement showing an accounting of changes to the Contract Sum.

    a. Complete administrative actions, submittals, and Work preceding this application, as described in Section 01 77 00 "Closeout Procedures."

2. This application shall reflect Certificate(s) of Substantial Completion issued previously for Owner occupancy of designated portions of the Work.

K. Final Payment Application: After completing Project closeout requirements, submit final Application for Payment with releases and supporting documentation not previously submitted and accepted, including, but not limited, to the following:

1. Evidence of completion of Project closeout requirements.
2. Certification of completion of final punch list items.
3. Insurance certificates for products and completed operations where required and proof that taxes, fees, and similar obligations were paid.
4. Updated final statement, accounting for final changes to the Contract Sum.
5. AIA Document G706.
6. AIA Document G706A.
7. AIA Document G707.
8. Evidence that claims have been settled.

9. Final meter readings for utilities, a measured record of stored fuel, and similar data as of date of Substantial Completion or when Owner took possession of and assumed responsibility for corresponding elements of the Work.
10. Final liquidated damages settlement statement.
11. Proof that taxes, fees, and similar obligations are paid.
12. Waivers and releases.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

This page is intentionally left blank.

SECTION 01 31 00 - PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative provisions for coordinating construction operations on Project, including, but not limited to, the following:

1. General coordination procedures.
2. Virtual design and construction (VDC), digital building information model (BIM), and coordination drawings.
3. Requests for Information (RFIs).
4. Digital project management procedures.
5. Web-based Project management software package.
6. Project meetings.

B. Related Requirements:

1. Section 01 32 00 "Construction Progress Documentation" for preparing and submitting Contractor's construction schedule.
2. Section 01 73 00 "Execution" for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points, and for cutting and patching for removal and reinstallation of historic architectural woodwork and historic marble columns.
3. Section 01 77 00 "Closeout Procedures" for coordinating closeout of the Contract.

1.2 DEFINITIONS

A. BIM: Building Information Modeling.

B. RFI: Request for Information. Request from Owner, Architect, or Contractor seeking information required by or clarifications of the Contract Documents.

1.3 INFORMATIONAL SUBMITTALS

A. Subcontract List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Include the following information in tabular form:

1. Name, address, telephone number, and email address of entity performing subcontract or supplying products.
2. Number and title of related Specification Section(s) covered by subcontract.
3. Drawing number and detail references, as appropriate, covered by subcontract.

B. Key Personnel Names: Within 15 days of starting construction operations, submit a list of key personnel assignments, including superintendent and other personnel in attendance at Project site. Identify individuals and their duties and responsibilities; list addresses, cellular telephone

numbers, and e-mail addresses. Provide names, addresses, and telephone numbers of individuals assigned as alternates in the absence of individuals assigned to Project.

1. Post copies of list in Project meeting room, in temporary field office, in web-based Project software directory, and in prominent location in built facility. Keep list current at all times.

1.4 GENERAL COORDINATION PROCEDURES

A. Coordination: Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations included in different Sections that depend on each other for proper installation, connection, and operation.

1. Schedule construction operations in sequence required to obtain the best results, where installation of one part of the Work depends on installation of other components, before or after its own installation.
2. Schedule disassembly, transport, storage, repairs and restoration, reinstallation and coordination with adjacent and associated work to ensure protection of historic materials at all times, proper access for workers, and proper installation, coordinated with other trades and work while maintaining project schedule.
3. Make adequate provisions to accommodate access to and movement of historic materials from existing site, for associated handling, repairs, and for effective reinstallation.
4. Coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair.
5. Make adequate provisions to accommodate items scheduled for later installation.

B. Prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and list of attendees at meetings.

1. Prepare similar memoranda for Owner and separate contractors if coordination of their Work is required.

C. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:

1. Preparation of Contractor's construction schedule.
2. Preparation of the schedule of values.
3. Installation and removal of temporary facilities and controls.
4. Removal, transport, repair, installation and coordination of historic materials.
5. Delivery and processing of submittals.
6. Progress meetings.
7. Preinstallation conferences.
8. Project closeout activities.
9. Startup and adjustment of systems.

D. Special Coordination Requirements for Mechanical and Electrical Work:

1. General: Provide necessary work and services required to coordinate the complete installation of heating, ventilating, and air conditioning (HVAC) equipment and systems;

plumbing systems and fixtures; electrical equipment, fixtures, and systems; and other equipment or systems containing motors and controls or requiring connection to mechanical or electrical systems.

2. Contract Drawings:

   a. Drawings are schematic in nature and indicate in general how the various components are integrated with other parts of the building. Coordinate exact locations by job measurement, by verifying the requirements of other trades, and by review of Contract Documents.

3. Mechanical and Electrical Drawings indicate general routing of the various parts of the systems, but do not indicate all sizes, fittings, offsets, and runouts which are required. Coordinate correct sizes, fittings, offsets, and runouts required to fit systems into allocated spaces. Coordinate locations of all light fixtures, vents, and supply grilles to conform to the ceiling grid system or other modular finishes.

E. Special Coordination Requirements for Exterior Envelope Work:

1. General: Provide necessary work and services required to coordinate the complete and continuous installation of the building's heat, air and moisture barriers. Exterior building envelope construction to be coordinated includes, but is not limited to, below-grade walls, slabs-on-grade, exterior opaque walls, windows, curtain walls, roofs, and skylights.
2. Contract Drawings:

   a. Drawings indicate general concepts and design intent for continuity of heat, air and moisture barriers at each exterior building envelope component and at transitions between building envelope components. Coordinate details for continuity based on actual product selections and Contractor's proposed sequence of construction.

3. Shop Drawings: Shop drawings of exterior envelope components and systems must accurately indicate adjacent construction, even if provided by other subcontractors, in order to demonstrate continuity of the heat, air and moisture barriers and compatibility of materials.

F. Special Coordination Requirements for Historic Work:

1. General: Provide necessary work and services required to coordinate the complete dismantling, rehabilitation and re-installation of historic marble columns and historic architectural woodwork with associated attachments and integrated components such as metal items mounted on historic wood paneling, from the existing Supreme Court of Maryland building to storage and shops as appropriate to the new Supreme Court of Maryland building.

   a. Drawings indicate general concepts and design intent for historic marble columns and architectural woodwork, including how these are to be reconfigured within the new building and how the various components are to be integrated with other parts of the building.

   b. General Contractor, historic restoration and all trades are to recognize that the historic marble columns and historic architectural woodwork are viewed by the State of Maryland as character-defining features which are closely associated with the history of the Supreme Court of Maryland. As such they are to be preserved and impacted as little as possible, while being installed in the new facility in compliance with applicable building codes, regulations and standards, to the

greatest extent possible while achieving this preservation with minimal impact. This requires use of the least damaging methods available for the work.

c. Historic materials and assemblies are to be investigated by specialists, qualifying with indicated requirements and approved for the work, before being moved or worked on. These specialists are to determine any relevant information such as regarding materials, conditions, dimensions, profiles, attachments, appropriate materials or methods for the work, and are to inform Architect and Owner through General Contractor of their findings and recommendations, then follow subsequent direction if different from or in addition to that in Contract Documents. The general concepts and design intent indicated in the Drawings are to be followed and achieved, and are to be carried further into adequate detail for successful performance of the work by the qualified specialists in the initial investigations, in all associated operations to accomplish the work, and in the required Quality-Control Programs and required written descriptions of Disassembly Methodologies, Shop Operations and Storage, Cleaning Methodologies, Repair Methodologies, and Installation Methodologies, including mockups.

d. Required preinstallation meetings are important for this work as are submittals, including shop drawings. For the architectural woodwork, these are to include designations (numbers and/or letters as deemed appropriate by qualified specialists) for each item of woodwork to be removed and reinstalled, such as units of wall panels, rails and stiles, carved ornamentation, entry door pediments, wood base, chair rail, cornice moulding and dentil course, such that all items to be relocated are designated, and drawings clearly indicate how they were combined and are to be recombined. Shop drawings must also indicate associated new work per Construction Drawings such as new architectural woodwork to match existing and how new woodwork is to meet reinstalled historic architectural woodwork. Also to indicate other connecting and adjacent work.

1.5 VIRTUAL DESIGN AND CONSTRUCTION (VDC), DIGITAL BUILDING INFORMATION MODEL (BIM) AND COORDINATION DRAWINGS

A. General: It is expected that, to the greatest extent applicable, Contractor will employ VDC and BIM tools to facilitate the construction, coordination, scheduling and phasing of the Work.

B. Contractor's VDC implementation shall include at a minimum the following activities:

1. Development and maintenance of a three-dimensional building information model of the Work that includes Contractor-developed, shop-drawing level information of the following building components and systems:

a. Building structure, including but not limited to, foundations, columns, beams, joists, purlins, floor and roof decking and fill, bracing, and load-bearing walls.
b. HVAC systems, including but not limited to, HVAC piping and pumps, air distribution ductwork, fans, air terminal units, air outlets and inlets; central cooling equipment compressors, chillers, condensers, and cooling towers; boilers, heat exchangers and packaged and/or custom air-handling units and thermal storage systems.
c. Plumbing systems, including but not limited to, water distribution, storm drainage and sanitary sewerage waste and vent piping, water-heaters and plumbing fixtures.

d. Fire suppression systems, including but not limited to, standpipes, sprinkler systems, fire pumps, and non-water-based fire-extinguishing systems.
e. Electrical systems, including but not limited to, conduit greater than 1-1/2 inches in diameter, or bundled conduits, cable-tray, transformers, switchgear, switchboards, panelboards, generators, lightning protection and lighting.
f. Communication systems, including but not limited to, structured cabling, premise wiring distribution system, equipment room fittings, racks, frames and enclosures, data communications switches, hubs, and routers, common use systems, and paging systems
g. Conveying systems including elevators, escalators, and moving walks.
h. Architectural building systems including interior and exterior walls, windows, curtain walls, ceilings, and roof.

2. Collision Detection Reports: Based on information developed and included in the Contractor's three-dimensional BIM model, perform collision/interference checking and develop reports for review and resolution by the integrated Contractor team, including subcontractors, manufacturers and suppliers, working with the Architect where needed prior to release of fabrication drawings.
3. Schedule Visualization: Develop and maintain a three-dimension building information model for the express purpose of visually demonstrating and communicating proposed project construction schedule and phasing to Owner, Architect, subcontractors and suppliers as applicable. The model shall include all major building systems and shall be constructed in such a fashion as to permit animation showing sequential construction of the project based on and driven by the approved construction scheduling software.

C. Coordination Model and Drawings, General: Using the Contractor-developed building information model, prepare coordination drawings and interference reports in accordance with requirements in individual Sections, and additionally where installation is not completely indicated on Shop Drawings, where limited space availability necessitates coordination, or if coordination is required to facilitate integration of products and materials fabricated or installed by more than one entity.

1. Content: Project-specific information, modeled and drawn accurately enough to indicate and resolve conflicts. Do not base coordination drawings on standard printed data. Include the following information, as applicable:

a. Use applicable model and Drawings as a basis for preparation of coordination drawings. Prepare sections, elevations, and details as needed to describe relationship of various systems and components.
b. Coordinate the addition of trade-specific information to the coordination model and drawings by multiple contractors in a sequence that best provides for coordination of the information and resolution of conflicts between installed components before submitting for review.
c. Incorporate support elements for all portions of the Work and provide suggested alternate routing to resolve spatial conflicts.
d. Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, and electrical systems.
e. Indicate space requirements for routine maintenance and for anticipated replacement of components during the life of the installation.
f. Show location and size of access doors required for access to concealed dampers, valves, and other controls.
g. Indicate required installation sequences.
h. Indicate dimensions shown on Drawings. Specifically note dimensions that appear to conflict with submitted equipment and minimum clearance requirements.

Provide alternate sketches to Architect indicating proposed resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.

D. Coordination Model and Drawing Organization: Organize coordination model and drawings as follows:

1. Floor Plans and Reflected Ceiling Plans: Show architectural and structural elements, and mechanical, plumbing, fire protection, fire alarm, and electrical Work. Show locations of visible ceiling-mounted devices relative to acoustical ceiling grid. Supplement plan drawings with section drawings where required to adequately represent the Work.
2. Plenum Space: Indicate subframing for support of ceiling and wall systems, mechanical and electrical equipment, and related Work. Locate components within plenums to accommodate layout of light fixtures and other components indicated on Drawings. Indicate areas of conflict between light fixtures and other components.
3. Mechanical Rooms: Provide coordination drawings for mechanical rooms showing plans and elevations of mechanical, plumbing, fire protection, fire alarm, and electrical equipment.
4. Structural Penetrations: Indicate penetrations and openings required for all disciplines.
5. Slab Edge and Embedded Items: Indicate slab edge locations and sizes and locations of embedded items for metal fabrications, sleeves, anchor bolts, bearing plates, angles, door floor closers, slab depressions for floor finishes, curbs and housekeeping pads, and similar items.
6. Mechanical and Plumbing Work: Show the following:

    a. Sizes and bottom elevations of ductwork, piping, and conduit runs, including insulation, bracing, flanges, and support systems.
    b. Dimensions of major components, such as dampers, valves, diffusers, access doors, cleanouts and electrical distribution equipment.
    c. Fire-rated enclosures around ductwork.

7. Electrical Work: Show the following:

    a. Runs of vertical and horizontal conduit 1-1/4 inch diameter and larger.
    b. Runs of multiple vertical and horizontal conduit that together measures 3 inches and larger.
    c. Cable tray.
    d. Light fixture, exit light, emergency battery pack, smoke detector, and other fire alarm locations.
    e. Panel board, switch board, switchgear, transformer, busway, generator, and motor control center locations.
    f. Location of pull boxes and junction boxes, dimensioned from column center lines.

8. Fire Protection System: Show the following:

    a. Locations of standpipes, mains piping, branch lines, pipe drops, isolation valves, pipe bracing and sprinkler heads.

9. Review: Architect will participate in BIM coordination and review meetings and will review coordination model and drawings to confirm that the Work is being coordinated, but not for the details of the coordination, which are the Contractor's responsibility. If the Architect determines that the coordination model and drawings are not being prepared in

sufficient scope or detail, or are otherwise deficient, the Architect will so inform the Contractor, who shall make suitable modifications and resubmit.

10. Interference Resolution: Whenever job measurements and an analysis of the building coordination model, Drawings and Specifications indicate that the various systems cannot be installed without significant deviation from the intent of the Contract, prepare interference drawings as required to indicate conflict between the various systems and other components of the building such as beams, columns, walls and seismic bracing. Include plans, elevations, sections, and other details drawn to large scale as required to clearly define the interference and to indicate the Contractor's proposed solution. Submit interference drawings for review by the Owner and Architect prior to proceeding with work in the general areas of the conflict.

E. Coordination Digital Data Files: Prepare coordination digital data files in accordance with the following requirements:

1. Model File Preparation Format: Same digital data software program, version, and operating system as the original Drawings.
2. Interference Checking File Format: Software capable of combining three-dimensional modeling information prepared in a variety of file formats to detect interference among disparate systems and objects.
3. File Submittal Format: Submit or post coordination drawing files using Portable Data File (PDF) format.
4. Architect will furnish Contractor one set of digital data files of the Drawings for use in preparing coordination digital data files.

    a. Architect makes no representations as to the accuracy or completeness of digital data files as they relate to the Drawings. It is expected that the Contractor will independently develop the content of the digital coordination model based on the design intent shown in the Architect’s digital model.
    b. Digital Data Software Program: The Architect’s Model and Drawings are available in the REVIT 2023 family of software.
    c. Contractor shall execute a data licensing agreement in the form of an Agreement form acceptable to Architect.

1.6 REQUEST FOR INFORMATION (RFI)

A. General: Immediately on discovery of the need for additional information, clarification, or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI in the form specified.

1. Architect will return without response those RFIs submitted to Architect by other entities controlled by Contractor.
2. Coordinate and submit RFIs in a prompt manner to avoid delays in Contractor's work or work of subcontractors.

B. Content of the RFI: Include a detailed, legible description of item needing information or interpretation and the following:

1. Project name.
2. Owner name.
3. Owner’s Project number.
4. Name of Architect.
5. Architect's Project number.

6. Date.
7. Name of Contractor.
8. RFI number, numbered sequentially.
9. RFI subject.
10. Specification Section number and title and related paragraphs, as appropriate.
11. Drawing number and detail references, as appropriate.
12. Field dimensions and conditions, as appropriate.
13. Contractor's suggested resolution. If Contractor's suggested resolution impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
14. Contractor's signature.
15. Attachments: Include sketches, descriptions, measurements, photos, Product Data, Shop Drawings, coordination drawings, and other information necessary to fully describe items needing interpretation.

    a. Include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments on attached sketches.

C. RFI Forms: Software-generated form with substantially the same content as indicated above, acceptable to Architect.

1. Attachments shall be electronic files in PDF format.

D. Architect's Action: Architect will review each RFI, determine action required, and respond. Allow fourteen days for Architect's response for each RFI. RFIs received by Architect after 1:00 p.m. Eastern Time will be considered as received the following working day.

1. The following Contractor-generated RFIs will be returned without action:

    a. Requests for approval of submittals.
    b. Requests for approval of substitutions.
    c. Requests for approval of Contractor's means and methods.
    d. Requests for coordination information already indicated in the Contract Documents.
    e. Requests for adjustments in the Contract Time or the Contract Sum.
    f. Requests for interpretation of Architect's actions on submittals.
    g. Incomplete RFIs or inaccurately prepared RFIs.

2. Architect's action may include a request for additional information, in which case Architect's time for response will date from time of receipt by Architect of additional information.
3. Architect's action on RFIs that may result in a change to the Contract Time or the Contract Sum may be eligible for Contractor to submit Change Proposal according to Section 01 26 00 "Contract Modification Procedures."

    a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Architect in writing within 7 days of receipt of the RFI response.

E. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log weekly. Use software log that is part of web-based Project management software. Include the following:

1. Project name.
2. Name and address of Contractor.

3. Name and address of Architect.
4. RFI number, including RFIs that were returned without action or withdrawn.
5. RFI description.
6. Date the RFI was submitted.
7. Date Architect's response was received.

F. On receipt of Architect's action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Architect within seven days if Contractor disagrees with response.

1.7 DIGITAL PROJECT MANAGEMENT PROCEDURES

A. Use of Architect's Digital Data Files: Subject to the requirements and restrictions in Article 1.5, "Virtual Design and Construction (VDC), Digital Building Information Model (BIM) and Coordination Drawings," digital data files of Architect's BIM model and CAD drawings, as applicable, will be provided by Architect for Contractor's use during construction.

1. Architect's BIM model and CAD drawings, as applicable, will be provided, subject to the following, one time only at the commencement of Work. It is the Contractor's responsibility to update and maintain his construction BIM model to include subsequent modifications issued by RFI, ASI, and Change Order.
2. Digital data files may be used by Contractor in preparing coordination drawings, Shop Drawings, and Project Record Drawings.
3. Architect makes no representations as to the accuracy or completeness of digital data files as they relate to Contract Drawings.
4. Digital Drawing Software Program: Contract Drawings are available in REVIT 2023.
5. Contractor shall execute a data licensing agreement in the form of Agreement included in Project Manual.

    a. Subcontractors and other parties granted access by Contractor to Architect's digital data files shall execute a data licensing agreement in the form of Agreement included with this section.

B. Web-Based Project Management Software Package: Provide, administer, and use web-based Project management software package for purposes of hosting and managing Project communication and documentation until Final Completion.

1. Web-based Project management software includes, at a minimum, the following features:

    a. Compilation of Project data, including Contractor, subcontractors, Architect, Architect's consultants, Owner, and other entities involved in Project. Include names of individuals and contact information.
    b. Access control for each entity for each workflow process, to determine entity's digital rights to create, modify, view, and print documents.
    c. Document workflow planning, allowing customization of workflow between project entities.
    d. Creation, logging, tracking, and notification for Project communications required in other Specification Sections, including, but not limited to, RFIs, submittals, Filed Orders - Minor Changes in the Work, Unilateral Change Orders, and Change Orders.
    e. Track status of each Project communication in real time, and log time and date when responses are provided.

f. Procedures for handling PDFs or similar file formats, allowing markups by each entity. Provide security features to lock markups against changes once submitted.
g. Processing and tracking of payment applications.
h. Processing and tracking of contract modifications.
i. Creating and distributing meeting minutes.
j. Document management for Drawings, Specifications, and coordination drawings, including revision control.
k. Management of construction progress photographs.
l. Mobile device compatibility, including smartphones and tablets.

2. Provide not less than thirty (30) Project management software user licenses for use of Owner, Owner's Commissioning Authority, Architect, and Architect's consultants. Provide software training for web-based Project software users.
3. At completion of Project, provide digital archive in format that is readable by common desktop software applications in format acceptable to Architect. Provide data in locked format to prevent further changes.

C. PDF Document Preparation: Where PDFs are required to be submitted to Architect, prepare as follows:

1. Assemble complete submittal package into a single indexed file, incorporating submittal requirements of a single Specification Section and transmittal form with links enabling navigation to each item.
2. Name file with a unique identifier, including revision identifier.

a. Refer to Section 01 33 00 "Submittal Procedures" for naming submittals.

3. Certifications: Where digitally submitted certificates and certifications are required, provide a digital signature with digital certificate on where indicated.

1.8 PROJECT MEETINGS

A. General: Schedule and conduct meetings and conferences at Project site unless otherwise indicated.

1. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify Owner and Architect of scheduled meeting dates and times a minimum of seven days prior to meeting.
2. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees.
3. Minutes: Entity responsible for conducting meeting will record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner, Construction Manager, and Architect, within five days of the meeting.

B. Preconstruction Conference: Owner will schedule and conduct a preconstruction conference before starting construction, at a time convenient to Owner and Architect, but no later than 15 days after execution of the Agreement.

1. Attendees: Authorized representatives of Owner, Owner's Commissioning Authority, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the conference. Participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.

2. Agenda: Discuss items of significance that could affect progress, including the following:

    a. Responsibilities and personnel assignments.
    b. Tentative construction schedule.
    c. Phasing.
    d. Critical work sequencing and long lead items.
    e. Removal, transport, storage, repair, and reinstallation of historic materials.
    f. Designation of key personnel and their duties.
    g. Historic work schedule within overall project schedule, necessary equipment, facilities, and conditions at each stage of the work.
    h. Historic work submittals including shop drawings, Quality Control Programs including personnel qualifications, required written descriptions such as Disassembly, Repair, and Installation Methodologies, and general description of work from initial investigation of historic assemblies through dismantling, transport, storage, repair, and installation.
    i. Lines of communications.
    j. Use of web-based Project software.
    k. Procedures for processing field decisions and Change Orders.
    l. Procedures for RFIs.
    m. Procedures for testing and inspecting.
    n. Procedures for processing Applications for Payment.
    o. Distribution of the Contract Documents.
    p. Submittal procedures.
    q. Sustainable design requirements.
    r. Preparation of Record Documents.
    s. Use of the premises.
    t. Work restrictions.
    u. Working hours.
    v. Owner's occupancy requirements.
    w. Responsibility for temporary facilities and controls.
    x. Procedures for moisture and mold control.
    y. Procedures for disruptions and shutdowns.
    z. Construction waste management and recycling.
    aa. Parking availability.
    bb. Office, work, and storage areas.
    cc. Equipment deliveries and priorities.
    dd. First aid.
    ee. Security.
    ff. Progress cleaning.

3. Minutes: Entity responsible for conducting meeting will record and distribute meeting minutes.

C. Sustainable Design Requirements Coordination Conference: Architect will schedule and conduct a sustainable design coordination conference before starting construction, at a time convenient to Owner, Architect, and Contractor.

1. Attendees: Authorized representatives of Owner, Owner's Commissioning Authority, Architect, and their consultants; Contractor and its superintendent and sustainable design coordinator; major subcontractors; suppliers; and other concerned parties shall attend the conference. Participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
2. Agenda: Discuss items of significance that could affect meeting sustainable design requirements, including the following:

a. Sustainable design Project checklist.
b. General requirements for sustainable design-related procurement and documentation.
c. Project closeout requirements and sustainable design certification procedures.
d. Role of sustainable design coordinator.
e. Construction waste management.
f. Construction operations and sustainable design requirements and restrictions.

3. Minutes: Entity responsible for conducting meeting will record and distribute meeting minutes.

D. Preinstallation Conferences: Conduct a preinstallation conference at Project site before each construction activity when required by other Sections and when required for coordination with other construction.

1. Attendees: Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise Architect, Construction Manager, and Owner Commissioning Authority of scheduled meeting dates.
2. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration, including requirements for the following:

a. Contract Documents.
b. Options.
c. Related RFIs.
d. Related Change Orders.
e. Purchases.
f. Deliveries.
g. Submittals.
h. Sustainable design requirements.
i. Review of mockups.
j. Possible conflicts.
k. Compatibility requirements.
l. Time schedules.
m. Weather limitations.
n. Manufacturer's written instructions.
o. Warranty requirements.
p. Compatibility of materials.
q. Acceptability of substrates.
r. Temporary facilities and controls.
s. Space and access limitations.
t. Regulations of authorities having jurisdiction.
u. Testing and inspecting requirements.
v. Installation procedures.
w. Coordination with other work.
x. Required performance results.
y. Protection of adjacent work.
z. Protection of construction and personnel.

3. Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.
4. Reporting: Distribute minutes of the meeting to each party present and to other parties requiring information.

5. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.

E. Project Closeout Conference: Schedule and conduct a project closeout conference, at a time convenient to Owner and Architect, but no later than 90 days prior to the scheduled date of Substantial Completion.

1. Conduct the conference to review requirements and responsibilities related to Project closeout.
2. Attendees: Authorized representatives of Owner, Owner's Commissioning Authority, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the meeting. Participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
3. Agenda: Discuss items of significance that could affect or delay Project closeout, including the following:

    a. Preparation of Record Documents.
    b. Procedures required prior to inspection for Substantial Completion and for final inspection for acceptance.
    c. Procedures for completing and archiving web-based Project software site data files.
    d. Submittal of written warranties.
    e. Requirements for completing sustainable design documentation.
    f. Requirements for preparing operations and maintenance data.
    g. Requirements for delivery of material samples, attic stock, and spare parts.
    h. Requirements for demonstration and training.
    i. Preparation of Contractor's punch list.
    j. Procedures for processing Applications for Payment at Substantial Completion and for final payment.
    k. Submittal procedures.
    l. Owner's partial occupancy requirements.
    m. Installation of Owner's furniture, fixtures, and equipment.
    n. Responsibility for removing temporary facilities and controls.

4. Minutes: Entity conducting meeting will record and distribute meeting minutes.

F. Progress Meetings: Architect will conduct progress meetings at bi-weekly intervals.

1. Attendees: In addition to representatives of Owner, Owner's Commissioning Authority, and Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
2. Agenda: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.

    a. Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties

involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.

1) Review schedule for next period.

b. Review present and future needs of each entity present, including the following:

1) Interface requirements.
2) Sequence of operations.
3) Resolution of BIM component conflicts.
4) Status of submittals.
5) Status of sustainable design documentation.
6) Deliveries.
7) Off-site fabrication.
8) Access.
9) Site use.
10) Temporary facilities and controls.
11) Progress cleaning.
12) Quality and work standards.
13) Status of correction of deficient items.
14) Field observations.
15) Status of RFIs.
16) Status of Proposal Requests.
17) Pending changes.
18) Status of Change Orders.
19) Pending claims and disputes.
20) Documentation of information for payment requests.

3. Minutes: Entity responsible for conducting the meeting will record and distribute the meeting minutes to each party present and to parties requiring information.

a. Schedule Updating: Revise Contractor's construction schedule after each progress meeting, where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with the report of each meeting.

G. Coordination Meetings: Conduct Project coordination meetings at monthly intervals. Project coordination meetings are in addition to specific meetings held for other purposes, such as progress meetings and preinstallation conferences.

1. Attendees: In addition to representatives of Owner, Owner's Commissioning Authority, and Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meetings shall be familiar with Project and authorized to conclude matters relating to the Work.
2. Agenda: Review and correct or approve minutes of the previous coordination meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.

a. Combined Contractor's Construction Schedule: Review progress since the last coordination meeting. Determine whether each contract is on time, ahead of schedule, or behind schedule, in relation to combined Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions

are required to ensure that current and subsequent activities will be completed within the Contract Time.

b. Schedule Updating: Revise combined Contractor's construction schedule after each coordination meeting, where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with report of each meeting.

c. Review present and future needs of each contractor present, including the following:

1) Interface requirements.
2) Sequence of operations.
3) Resolution of BIM component conflicts.
4) Status of submittals.
5) Deliveries.
6) Off-site fabrication.
7) Access.
8) Site use.
9) Temporary facilities and controls.
10) Work hours.
11) Hazards and risks.
12) Progress cleaning.
13) Quality and work standards.
14) Status of RFIs.
15) Proposal Requests.
16) Change Orders.
17) Pending changes.

3. Reporting: Record meeting results and distribute copies to everyone in attendance and to others affected by decisions or actions resulting from each meeting.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 SCHEDULE OF PRE-INSTALLATION MEETINGS TO BE CONDUCTED

A. Schedule pre-installation meetings at Project Site where required in each technical Section of these specifications.

END OF SECTION

This page is intentionally left blank.

DIGITAL DATA LICENSING AND INDEMNITY AGREEMENT

BETWEEN: Fentress Architects
421 Broadway
Denver, Colorado 80203

AND: **<Legal Company Name>** **(Transferee)**
<street address>
<city, state, zip>

Project: **Supreme Court of Maryland**
Project #: **20190058**

WHEREAS Transferee has asked Fentress Architects to provide copies of, or access to, certain drawings, including CAD Data Files, specifications, or other electronic documents and/or building information models ("BIM Files"), collectively "Data," prepared by Fentress Architects and/or one or more consultants of Fentress for the above-referenced Project. Throughout this Agreement, "Fentress Architects" shall include its consultants who have contributed to the preparation of the Data.

THE PARTIES AGREE AS FOLLOWS:

1. The Transferee is granted a limited non-exclusive license to use the Data only for the specific purpose of preparing documents for the above-referenced Project. The transfer of Data is not and shall not be deemed a sale. The Data are instruments of service. Fentress Architects and it consultants, as appropriate, shall be deemed the author of the Data transferred and shall retain all proprietary rights, including any copyrights, embodied therein. Unless otherwise explicitly agreed to in writing by the parties, this Agreement shall govern any and all future data transfers to Transferee by Fentress Architects.

2. The Data are furnished "as is." Fentress Architects disclaims all warranties with regard to the Data supplied hereunder, including all implied warranties of fitness for a particular purpose. The use of Data is permitted as a convenience for Transferee and they do not replace the Contract Documents. Transferee shall be solely responsible for confirming the accuracy, completeness and appropriateness of the Data for the use intended by Transferee. Fentress Architects disclaims all obligations or liabilities for damages, including, but not limited to, consequential damages arising out of or in connection with the use or functionality of the Data.

3. Subject to Paragraph 4 below, the Transferee may copy the Data, in whole or in part, only for backup and archival purposes and for use by is contractors, subcontractors, suppliers, and consultants (collectively "Others"), provided Transferee requires the Others who receive a copy of the Data, in whole or in part, to be bound by the terms and conditions of this Agreement as if they were the Transferee in this Agreement and particularly the confidentiality provisions of Section 4.

4. The Transferee agrees that the Data is an asset of Fentress Architects, is not generally known to the trade or the public, is of a confidential nature and, to preserve the goodwill of Fentress Architects, must be kept strictly confidential and used only for the purposes stated in this Agreement. While this Agreement is in effect and for a period of five (5) years after the termination of this Agreement, the Transferee agrees that it will not use, disclose, communicate, copy or permit the use or disclosure of any of the Data to any third party in any manner whatsoever except as permitted by Paragraph 3 above or as otherwise directed by Fentress Architects. Upon termination of this Agreement or upon the request of Fentress Architects, the Transferee will return to Fentress Architects or destroy all of the Data, and all copies or reproductions thereof that are in Transferee's

possession or control unless such is required to be maintained by law, in which event, the confidentiality obligations hereunder shall remain in effect until such documentation may legally be destroyed or returned to Fentress. Transferee agrees that the disclosure of the Data could cause irreparable harm to Fentress Architects and that the amount of damages related thereto would be extremely difficult to estimate. Accordingly, it is understood and agreed that monetary damages are not a sufficient remedy for a breach of this Paragraph 4 and that specific performance and injunctive relief shall be considered appropriate remedies for the restraint of such breach or any threat of such breach.

5. In order to facilitate the transfer of electronic media, Fentress Architects may provide the Transferee with file transfer protocol (FTP) site access or cloud-based collaboration software. Transferee may copy Files from this site in whole or in part, only for use in preparing submittal documents, for backup and archival purposes, and for use by the Transferee's sub-contractors pursuant to Paragraph 2 of this Agreement. As part of this Agreement, access to the FTP site or cloud-based collaboration software is granted via user name and password which must not be shared outside of the Transferee's company. Failure to comply will result in termination of access privileges.

6. Transferee acknowledges that anomalies and errors may occur when the Data is transferred electronically or used in an incompatible computer environment. Additionally, electronic media may not be suitable for long term archival purposes due to natural deterioration of the media over time and the potential incompatibility with future hardware and software upgrades. The Transferee is responsible for verification of the Data upon receipt. Fentress Architects has no way of controlling the handling and storage of the Data once it is released to Transferee and disclaims any responsibility for loss of Data or malfunctions in the Transferee's computer equipment.

7. Fentress Architects shall have no duty to modify or update the Data. Fentress Architects may retain an archival copy of the Data, which shall be conclusive proof and govern in any dispute over the Data's form or content.

8. To the extent the Data include Building Information Model Files (BIM Files), the parties agree to the following additional terms: (i) the BIM Files are intended for the purpose of communicating design intent. However, not all project elements are modeled and therefore there are elements which are not included in the BIM Files but may only be shown on other Data or on drawings, specifications or other documents which are not presented as electronic documents. Therefore, while the BIM Files may be helpful to illustrate conflicts or inconsistencies in the design, the BIM Files will not detect all conflicts or inconsistencies; (ii) Any use of the BIM Files for the purpose of generating quantity take-offs or cost estimates, or for fabrication, will be at the Transferee's sole risk; (iii) As with Fentress Architects other services and deliverables, while the BIM Files will be prepared using that degree of skill and care exercised by licensed professionals practicing in the same community, under the same or similar circumstances, they are nonetheless subject to the limitations and provisions of Paragraph 2 and the other subparagraphs of this Paragraph. The BIM Files may contain or be based upon data or information provided by others. Architect has relied upon such data or information as is consistent with industry practice and the professional standard of care; (iv) Information contained in the BIM Files will not be construed to dictate construction means, methods, techniques, sequences or procedures of construction, safety programs or precautions or installation methods, all of which will remain the contractor's responsibility; (v) To the extent of any conflict between information contained in, or generated by, the BIM Files and the Contract Documents including Fentress Architect's drawings and specifications, the latter documents will prevail.

9. Transferee agrees to indemnify and hold Fentress Architects and its consultants and each of their owners, officers, directors, shareholders, employees and agents harmless from and against any and all claims, liabilities, suits, demands, losses, damages, costs, and expenses, including but not limited to, reasonable attorney's fees and all legal expenses and fees incurred through appeal, and all interest thereon, accruing to or resulting from any and all persons, firms or any other legal entities on account of any damages or losses to property or persons, including, but not limited to, injuries, death or economic losses, arising out of Transferee's or Others' use, reuse, transfer, or modification

of the Data, except where a court or forum of competent jurisdiction determines that Fentress Architects is solely liable for such damages or losses.

10. This Agreement shall be governed by the law of the State of Colorado.

11. In any legal proceeding to enforce this Agreement, the prevailing party shall be entitled to recover its reasonable attorneys' fees and costs of defense.

12. The parties agree that Fentress Architects' consultants are intended third-party beneficiaries of this Agreement including having the right to enforce the provisions of Paragraph 9 (Indemnification) and Paragraph 11 (Attorneys' Fees and Costs).

13. If Transferee fails to perform or observe any of the terms of this Agreement, Fentress Architects may demand, and Transferee must immediately return, the Data and any copies thereof.

It is expressly understood and agreed that the Transferee signatory below is authorized to represent all parties employed by the Transferee and all terms and conditions of this Agreement are binding to all parties associated therewith.

<Transferee Legal Company Name>

By: _____ Date: _____
<Print Transferee Signatory Name Here>

Fentress Architects

By: _____ Date: _____
Curtis W. Fentress, President & CEO

SECTION 01 32 00 - CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work, including the following:

1. Startup construction schedule.
2. Contractor's Construction Schedule.
3. Construction schedule updating reports.
4. Daily construction reports.
5. Material location reports.
6. Site condition reports.
7. Unusual event reports.

B. The Owner has employed the services of a Construction Media Documentation firm for the duration of the construction period. The Contractor shall provide access to the construction area for the purposes of photo documentation.

C. Related Requirements:

1. Section 01 40 00 "Quality Requirements" for schedule of tests and inspections.
2. Section 01 29 00 "Payment Procedures" for schedule of values and requirements for use of cost-loaded schedule for Applications for Payment.

1.2 DEFINITIONS

A. Activity: A discrete part of a project that can be identified for planning, scheduling, monitoring, and controlling the construction Project. Activities included in a construction schedule consume time and resources.

1. Critical Activity: An activity on the critical path that must start and finish on the planned early start and finish times.
2. Predecessor Activity: An activity that precedes another activity in the network.
3. Successor Activity: An activity that follows another activity in the network.

B. Cost Loading: The allocation of the schedule of values for completing an activity as scheduled. The sum of costs for all activities must equal the total Contract Sum.

C. CPM: Critical path method, which is a method of planning and scheduling a construction project where activities are arranged based on activity relationships. Network calculations determine the critical path of Project and when activities can be performed.

D. Critical Path: The longest connected chain of interdependent activities through the network schedule that establishes the minimum overall Project duration and contains no float.

E. Event: The starting or ending point of an activity.

F. Float: The measure of leeway in starting and completing an activity.

1. Float time is not for the exclusive use or benefit of either Owner or Contractor, but is a jointly owned, expiring Project resource available to both parties as needed to meet schedule milestones and Contract completion date.
2. Free float is the amount of time an activity can be delayed without adversely affecting the early start of the successor activity.
3. Total float is the measure of leeway in starting or completing an activity without adversely affecting the planned Project completion date.

G. Resource Loading: The allocation of manpower and equipment necessary for completing an activity as scheduled.

H. Fragnet: A partial or fragmentary network that breaks down activities into smaller activities for greater detail.

I. Long Lead Time: An item having a fabrication and delivery time greater than ninety (90) days from the time of order.

J. Major Area: A story of construction, a separate building, or a similar significant construction element.

1.3 INFORMATIONAL SUBMITTALS

A. Format for Submittals: Submit required submittals in the following formats:

1. Working electronic copy of schedule file.
2. PDF file.

B. Startup construction schedule.

1. Submittal of cost-loaded startup construction schedule will not constitute approval of schedule of values for cost-loaded activities.

C. Startup Network Diagram: Of size required to display entire network for entire construction period. Show logic ties for activities.

D. Contractor's Construction Schedule: Initial schedule, of size required to display entire schedule for entire construction period.

1. Submit a working digital copy of schedule, using software indicated, and labeled to comply with requirements for submittals.

E. CPM Reports: Concurrent with CPM schedule, submit each of the following reports. Format for each activity in reports shall contain activity number, activity description, cost and resource loading, original duration, remaining duration, early start date, early finish date, late start date, late finish date, and total float in calendar days.

1. Activity Report: List of activities sorted by activity number and then early start date, or actual start date if known.

2. Logic Report: List of preceding and succeeding activities for each activity, sorted in ascending order by activity number and then by early start date, or actual start date if known.
3. Total Float Report: List of activities sorted in ascending order of total float.
4. Earnings Report: Compilation of Contractor's total earnings from commencement of the work until most recent Application for Payment.

F. Construction Schedule Updating Reports: Submit with Applications for Payment.

G. Daily Construction Reports: Submit at monthly intervals.

H. Material Location Reports: Submit at monthly intervals.

I. Site Condition Reports: Submit at time of discovery of differing conditions.

J. Unusual Event Reports: Submit at time of unusual event.

K. Qualification Data: For scheduling consultant.

1.4 QUALITY ASSURANCE

A. Scheduling Consultant Qualifications: An experienced specialist in CPM scheduling and reporting, with capability of producing CPM reports and diagrams within 24 hours of Architect's request.

B. Prescheduling Conference: Conduct conference at Project site to comply with requirements in Section 01 31 00 "Project Management and Coordination." Review methods and procedures related to the preliminary construction schedule and Contractor's Construction Schedule, including, but not limited to, the following:

1. Review software limitations and content and format for reports.
2. Verify availability of qualified personnel needed to develop and update schedule.
3. Discuss constraints, including phasing, work stages, area separations, interim milestones and partial Owner occupancy.
4. Review delivery dates for Owner-furnished products.
5. Review schedule for work of Owner's separate contracts.
6. Review submittal requirements and procedures.
7. Review time required for review of submittals and resubmittals.
8. Review requirements for tests and inspections by independent testing and inspecting agencies.
9. Review time required for Project closeout and Owner startup procedures, including commissioning activities.
10. Review and finalize list of construction activities to be included in schedule.
11. Review procedures for updating schedule.

1.5 COORDINATION

A. Coordinate Contractor's Construction Schedule with the Schedule of Values, list of subcontracts, submittal schedule, progress reports, payment requests, and other required schedules and reports.

1. Secure time commitments for performing critical elements of the Work from parties involved.
2. Coordinate each construction activity in the network with other activities, and schedule them in proper sequence.

1.6 CONTRACTOR'S CONSTRUCTION SCHEDULE

A. Computer Scheduling Software: Prepare schedules using current version of a program that has been developed specifically to manage construction schedules.

1. Use Primavera for current Windows operating system.

B. Scheduling Consultant: Engage a consultant to provide planning, evaluation, and reporting, using CPM scheduling.

1. In-House Option: Owner may waive requirement to retain a consultant if Contractor employs skilled personnel with experience in CPM scheduling and reporting techniques. Submit qualifications.
2. Meetings: Scheduling consultant shall attend all meetings related to Project progress, alleged delays, and time impact.

A. Time Frame: Extend schedule from date established for the Notice to Proceed to date of Substantial Completion.

1. Contract completion date shall not be changed by submission of a schedule that shows an early completion date, unless specifically authorized by Change Order.

B. Activities: Treat each floor or separate area as a separate numbered activity for each main element of the Work. Comply with the following:

1. Activity Duration: Define activities so no activity is longer than 20 working days, unless specifically allowed by Architect.
2. Temporary Facilities: Indicate start and completion dates for the following as applicable:

    a. Securing of approvals and permits required for performance of the Work.
    b. Temporary facilities.
    c. Construction of mock-ups, prototypes and samples.
    d. Owner interfaces and furnishing of items.
    e. Interfaces with Separate Contracts.
    f. Regulatory agency approvals.
    g. Punch list.

3. Procurement Activities: Include procurement process activities for long lead-time items and major items, requiring a cycle of more than 60 days, as separate activities in schedule. Procurement cycle activities include, but are not limited to, submittals, approvals, purchasing, fabrication, and delivery.
4. Submittal Review Time: Include review and resubmittal times indicated in Section 01 33 00 "Submittal Procedures" in schedule. Coordinate submittal review times in Contractor's Construction Schedule with submittal schedule.
5. Startup and Testing Time: Include no fewer than 30 days for startup and testing.
6. Commissioning Time: Include no fewer than 60 days for commissioning.

7. Substantial Completion: Indicate completion in advance of date established for Substantial Completion and allow time for Architect's administrative procedures necessary for certification of Substantial Completion.
8. Punch List and Final Completion: Include not more than 30 days for completion of punch list items and Final Completion.

C. Constraints: Include constraints and work restrictions indicated in the Contract Documents and as follows in schedule and show how the sequence of the Work is affected.

1. Work Restriction: Show the effect of the following items on the schedule:

    a. Uninterruptible services.
    b. Partial occupancy before Substantial Completion.
    c. Seasonal variations.
    d. Environmental control.

2. Work Stages: Indicate important stages of construction for each major portion of the Work, including, but not limited to, the following:

    a. Subcontract awards.
    b. Submittals.
    c. Purchases.
    d. Mockups.
    e. Fabrication.
    f. Sample testing.
    g. Deliveries.
    h. Installation.
    i. Tests and inspections.
    j. Adjusting.
    k. Curing.
    l. Building flush-out.
    m. Startup and placement into final use and operation.
    n. Commissioning.

3. Construction Areas: Identify each major area of construction for each major portion of the Work. Indicate where each construction activity within a major area must be sequenced or integrated with other construction activities to provide for the following:

    a. Structural completion.
    b. Temporary enclosure and space conditioning.
    c. Permanent space enclosure.
    d. Completion of mechanical installation.
    e. Completion of electrical installation.
    f. Substantial Completion.

D. Milestones: Include milestones indicated in the Contract Documents in schedule, including, but not limited to, the Notice to Proceed, Substantial Completion, Final Completion, and the following interim milestones:

1. Temporary enclosure and space conditioning.

E. Cost Correlation: Superimpose a cost correlation timeline, indicating planned and actual costs. On the line, show planned and actual dollar volume of the Work performed as of planned and actual dates used for preparation of payment requests.

1. See Section 01 29 00 “Payment Procedures” for cost reporting and payment procedures.

F. Upcoming Work Summary: Prepare summary report indicating activities scheduled to occur or commence prior to submittal of next schedule update. Summarize the following issues:

1. Unresolved issues.
2. Unanswered Requests for Information.
3. Rejected or unreturned submittals.
4. Notations on returned submittals.
5. Pending modifications affecting the Work and the Contract Time.

G. Contractor's Construction Schedule Updating: At monthly intervals, update schedule to reflect actual construction progress and activities. Issue schedule one week before each regularly scheduled progress meeting.

1. Revise schedule immediately after each meeting or other activity where revisions have been recognized or made. Issue updated schedule concurrently with the report of each such meeting.
2. Include a report with updated schedule that indicates every change, including, but not limited to, changes in logic, durations, actual starts and finishes, and activity durations.
3. As the Work progresses, indicate Final Completion percentage for each activity.

H. Recovery Schedule: When periodic update indicates the Work is 14 or more calendar days behind the current approved schedule, submit a separate recovery schedule indicating means by which Contractor intends to regain compliance with the schedule. Indicate changes to working hours, working days, crew sizes, equipment required to achieve compliance, and date by which recovery will be accomplished.

I. Distribution: Distribute copies of approved and updated schedules to Architect, Owner, separate contractors, testing and inspecting agencies, and other parties identified by Contractor with a need-to-know schedule responsibility.

1. Post copies in Project meeting rooms and temporary field offices.
2. When revisions are made, distribute updated schedules to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in performance of construction activities.

1.7 CPM SCHEDULE REQUIREMENTS

A. Prepare network diagrams using AON (activity-on-node) format.

B. Startup Network Diagram: Submit diagram within 14 days of date established for the Notice to Proceed. Outline significant construction activities for the first 90 days of construction. Include skeleton diagram for the remainder of the Work and a cash requirement prediction based on indicated activities.

C. CPM Schedule: Prepare Contractor's Construction Schedule using a cost- and resource-loaded, time-scaled CPM network analysis diagram for the Work.

1. Develop network diagram in sufficient time to submit CPM schedule, so it can be accepted for use no later than 60 days after date established for the Notice to Proceed.

    a. Failure to include any work item required for performance of this Contract shall not excuse Contractor from completing all work within applicable completion dates.

2. Conduct educational workshops to train and inform key Project personnel, including subcontractors' personnel, in proper methods of providing data and using CPM schedule information.
3. Establish procedures for monitoring and updating CPM schedule and for reporting progress. Coordinate procedures with progress meeting and payment request dates.
4. Use "one workday" as the unit of time for individual activities. Indicate nonworking days and holidays incorporated into the schedule to coordinate with the Contract Time.

D. CPM Schedule Preparation: Prepare a list of all activities required to complete the Work. Using the startup network diagram, prepare a skeleton network to identify probable critical paths.

1. Activities: Indicate the estimated time duration, sequence requirements, and relationship of each activity in relation to other activities. Include estimated time frames for the following activities:

    a. Preparation and processing of submittals.
    b. Mobilization and demobilization.
    c. Purchase of materials.
    d. Delivery.
    e. Fabrication.
    f. Utility interruptions.
    g. Installation.
    h. Work by Owner that may affect or be affected by Contractor's activities.
    i. Testing and inspection.
    j. Commissioning.
    k. Punch list and Final Completion.
    l. Activities occurring following Final Completion.

2. Critical Path Activities: Identify critical path activities, including those for interim completion dates. Scheduled start and completion dates shall be consistent with Contract milestone dates.
3. Processing: Process data to produce output data on a computer-drawn, time-scaled network. Revise data, reorganize activity sequences, and reproduce as often as necessary to produce the CPM schedule within the limitations of the Contract Time.
4. Format: Mark the critical path. Locate the critical path near center of network; locate paths with most float near the edges.

    a. Subnetworks on separate sheets are permissible for activities clearly off the critical path.

5. Cost- and Resource-Loading of CPM Schedule: Assign cost to construction activities on the CPM schedule. Do not assign costs to submittal activities. Obtain Architect's approval prior to assigning costs to fabrication and delivery activities. Assign costs under main subcontracts for testing and commissioning activities, operation and maintenance

manuals, punch list activities, Project record documents, sustainable design documentation, and demonstration and training (if applicable), in the amount of 5 percent of the Contract Sum.

a. Each activity cost shall reflect an appropriate value subject to approval by Architect.
b. Total cost assigned to activities shall equal the total Contact Sum.

E. Contract Modifications: For each proposed contract modification and concurrent with its submission, prepare a time-impact analysis using a network fragment to demonstrate the effect of the proposed change on the overall Project schedule.

F. Initial Issue of Schedule: Prepare initial network diagram from a sorted activity list indicating straight "early start-total float." Identify critical activities. Prepare tabulated reports showing the following:

1. Contractor or subcontractor and the Work or activity.
2. Description of activity.
3. Main events of activity.
4. Immediately preceding and succeeding activities.
5. Early and late start dates.
6. Early and late finish dates.
7. Activity duration in workdays.
8. Total float or slack time.
9. Average size of workforce.
10. Dollar value of activity (coordinated with the Schedule of Values).

G. Schedule Updating: Concurrent with making revisions to schedule, prepare tabulated reports showing the following:

1. Identification of activities that have changed.
2. Changes in early and late start dates.
3. Changes in early and late finish dates.
4. Changes in activity durations in workdays.
5. Changes in the critical path.
6. Changes in total float or slack time.
7. Changes in the Contract Time.

H. Value Summaries: Prepare two cumulative value lists, sorted by finish dates.

1. In first list, tabulate activity number, early finish date, dollar value, and cumulative dollar value.
2. In second list, tabulate activity number, late finish date, dollar value, and cumulative dollar value.
3. In subsequent issues of both lists, substitute actual finish dates for activities completed as of list date.
4. Prepare list for ease of comparison with payment requests, coordinate timing with progress meetings.

a. In both value summary lists, tabulate "actual percent complete" and "cumulative value completed" with total at bottom.
b. Submit value summary printouts one week before each regularly scheduled progress meeting.

1.8 REPORTS

A. Daily Construction Reports: Prepare a daily construction report recording the following information concerning events at Project site:

1. List of subcontractors at Project site.
2. List of separate contractors at Project site.
3. Approximate count of personnel at Project site.
4. Equipment at Project site.
5. Material deliveries.
6. High and low temperatures and general weather conditions, including presence of rain or snow.
7. Testing and inspection.
8. Accidents.
9. Meetings and significant decisions.
10. Unusual events.
11. Stoppages, delays, shortages, and losses.
12. Meter readings and similar recordings.
13. Emergency procedures.
14. Orders and requests of authorities having jurisdiction.
15. Change Orders received and implemented.
16. Construction Change Directives received and implemented.
17. Services connected and disconnected.
18. Equipment or system tests and startups.
19. Partial completions and occupancies.
20. Substantial Completions authorized.

B. Material Location Reports: At monthly intervals, prepare and submit a comprehensive list of materials delivered to and stored at Project site. List shall be cumulative, showing materials previously reported plus items recently delivered. Include with list a statement of progress on and delivery dates for materials or items of equipment fabricated or stored away from Project site. Indicate the following categories for stored materials:

1. Material stored prior to previous report and remaining in storage.
2. Material stored prior to previous report and since removed from storage and installed.
3. Material stored following previous report and remaining in storage.

C. Site Condition Reports: Immediately on discovery of a difference between site conditions and the Contract Documents, prepare and submit a detailed report. Submit with a Request for Information. Include a detailed description of the differing conditions, together with recommendations for changing the Contract Documents.

D. Unusual Event Reports: When an event of an unusual and significant nature occurs at Project site, whether or not related directly to the Work, prepare and submit a special report. List chain of events, persons participating, responses by Contractor's personnel, evaluation of results or effects, and similar pertinent information. Advise Owner in advance when these events are known or predictable.

1. Submit unusual event reports directly to Owner within one day(s) of an occurrence. Distribute copies of report to parties affected by the occurrence.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

SECTION 01 33 00 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Submittal schedule requirements.
2. Administrative and procedural requirements for submittals.

B. Related Requirements:

1. Section 01 29 00 "Payment Procedures" for submitting Applications for Payment and the schedule of values.
2. Section 01 31 00 "Project Management and Coordination" for submitting coordination drawings and subcontract list and for requirements for web-based Project software.
3. Section 01 32 00 "Construction Progress Documentation" for submitting schedules and reports, including Contractor's construction schedule.
4. Section 01 40 00 "Quality Requirements" for submitting test and inspection reports, and schedule of tests and inspections.
5. Section 01 77 00 "Closeout Procedures" for submitting closeout submittals and maintenance material submittals.
6. Section 01 78 23 "Operation and Maintenance Data" for submitting operation and maintenance manuals.
7. Section 01 78 39 "Project Record Documents" for submitting record Drawings, record Specifications, and record Product Data.
8. Section 01 79 00 "Demonstration and Training" for submitting video recordings of demonstration of equipment and training of Owner's personnel.

1.2 DEFINITIONS

A. Action Submittals: Written and graphic information and physical samples that require Architect's responsive action. Action submittals are those submittals indicated in individual Specification Sections as "action submittals."

B. Informational Submittals: Written and graphic information and physical samples that do not require Architect's responsive action. Submittals may be rejected for not complying with requirements. Informational submittals are those submittals indicated in individual Specification Sections as "informational submittals."

1.3 SUBMITTAL SCHEDULE

A. Submittal Schedule: Submit, as an action submittal, a list of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, ordering, manufacturing, fabrication, and delivery when establishing dates. Include additional time required for making corrections or revisions to submittals noted by Architect and additional time for handling and reviewing submittals required by those corrections.

1. Coordinate submittal schedule with list of subcontracts, the schedule of values, and Contractor's construction schedule.
2. Initial Submittal Schedule: Submit concurrently with startup construction schedule. Include submittals required during the first 60 days of construction. List those submittals required to maintain orderly progress of the Work and those required early because of long lead time for manufacture or fabrication.
3. Final Submittal Schedule: Submit concurrently with the first complete submittal of Contractor's construction schedule.

    a. Submit revised submittal schedule as required to reflect changes in current status and timing for submittals.

4. Format: Arrange the following information in a tabular format:

    a. Scheduled date for first submittal.
    b. Specification Section number and title.
    c. Submittal Category: Action; informational.
    d. Name of subcontractor.
    e. Description of the Work covered.
    f. Scheduled date for Architect's final release or approval.
    g. Scheduled dates for purchasing.
    h. Scheduled date of fabrication.
    i. Scheduled dates for installation.
    j. Activity or event number.

1.4 SUBMITTAL FORMATS

A. Submittal Information: Include the following information in each submittal:

1. Project name.
2. Date.
3. Name of Architect.
4. Name of Contractor.
5. Name of firm or entity that prepared submittal.
6. Names of subcontractor, manufacturer, and supplier.
7. Unique submittal number, including revision identifier. Include Specification Section number with sequential alphanumeric identifier and alphanumeric suffix for resubmittals.

    a. File names shall be in the following format: “061000-PD-001” where “061000” is the specification section, “PD” indicates the submittal type as product data, and “001” is the first sequential numeric identifier.
    b. Resubmittals shall include an alphabetic suffix after a decimal point (e.g., 061000-PD-001.A).
    c. Submittal Type Identifiers:

        1) PD: Product Data.
        2) SD: Shop Drawings.
        3) SA: Samples.
        4) O: Other.

8. Category and type of submittal.
9. Submittal purpose and description.

10. Number and title of Specification Section, with paragraph number and generic name for each of multiple items.
11. Drawing number and detail references, as appropriate.
12. Indication of full or partial submittal.
13. Location(s) where product is to be installed, as appropriate.
14. Other necessary identification.
15. Remarks.
16. Signature of transmitter.

B. Options: Identify options requiring selection by Architect.

C. Deviations and Additional Information: On each submittal, clearly indicate deviations from requirements in the Contract Documents, including minor variations and limitations; include relevant additional information and revisions, other than those requested by Architect on previous submittals. Indicate by highlighting on each submittal or noting on attached separate sheet.

D. Submittals Utilizing Web-Based Project Software: Prepare submittals as PDF package, incorporating complete information into each PDF file. Name PDF file with submittal number.

1.5 SUBMITTAL PROCEDURES

A. Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.

1. Web-Based Project Management Software: Prepare submittals in PDF form, and upload to web-based Project management software website. Enter required data in web-based software site to fully identify submittal.
2. Submit PDFs at native size, right-side up. Illegible files will be rejected.

B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.

1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
2. Submit all submittal items required for each Specification Section concurrently unless partial submittals for portions of the Work are indicated on approved submittal schedule.
3. Submit action submittals and informational submittals required by the same Specification Section as separate packages under separate transmittals.
4. Coordinate transmittal of submittals for related parts of the Work specified in different Sections, so processing will not be delayed because of need to review submittals concurrently for coordination.

    a. Architect reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.

C. Processing Time: Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Architect's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.

1. Submittal Size: The following durations apply to submittals containing 50 drawings or less. Add 7 days for each additional 50 drawings or portion thereof.
2. Initial Review: Allow 21 days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Architect will advise Contractor when a submittal being processed must be delayed for coordination.
3. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
4. Resubmittal Review: Allow 21 days for review of each resubmittal.
5. Sequential Review: Where sequential review of submittals by Architect's consultants, Owner, or other parties is indicated, allow 21 days for initial review of each submittal.

D. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.

1. Note date and content of previous submittal.
2. Note date and content of revision in label or title block, and clearly indicate extent of revision.
3. Resubmit submittals until they are marked with approval notation from Architect's action stamp.

E. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.

F. Use for Construction: Retain complete copies of submittals on Project site. Use only final action submittals that are marked with approval notation from Architect's action stamp.

1.6 SUBMITTAL REQUIREMENTS

A. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.

1. If information must be specially prepared for submittal because standard published data are unsuitable for use, submit as Shop Drawings, not as Product Data.
2. Mark each copy of each submittal to show which products and options are applicable.
3. Include the following information, as applicable:

    a. Manufacturer's catalog cuts.
    b. Manufacturer's product specifications.
    c. Standard color charts.
    d. Statement of compliance with specified referenced standards.
    e. Testing by recognized testing agency.
    f. Application of testing agency labels and seals.
    g. Notation of coordination requirements.
    h. Availability and deliver time information.

4. For equipment, include the following in addition to the above, as applicable:

    a. Wiring diagrams that show factory-installed wiring.
    b. Printed performance curves.
    c. Operational range diagrams.
    d. Clearances required to other construction, if not indicated on accompanying Shop Drawings.

5. Submit Product Data before Shop Drawings, and before or concurrently with Samples.

B. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data unless submittal based on Architect's digital data drawing files is otherwise permitted.

1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:

    a. Identification of products.
    b. Schedules.
    c. Compliance with specified standards.
    d. Notation of coordination requirements.
    e. Notation of dimensions established by field measurement.
    f. Relationship and attachment to adjoining construction clearly indicated.
    g. Seal and signature of professional engineer if specified.

2. Sheet Size: Except for templates, patterns, and similar full-size Drawings, submit electronic files of Shop Drawings on sheets that when printed full-size are at least 8-1/2 by 11 inches but no larger than 30 by 42 inches.
3. BIM Incorporation: Develop and incorporate Shop Drawing files into BIM established for Project.

C. Samples: Submit Samples for review of type, color, pattern, and texture for a check of these characteristics with other materials.

1. Transmit Samples that contain multiple, related components, such as accessories together in one submittal package.
2. Identification: Permanently attach label on unexposed side of Samples that includes the following:

    a. Project name and submittal number.
    b. Generic description of Sample.
    c. Product name and name of manufacturer.
    d. Sample source.
    e. Number and title of applicable Specification Section.
    f. Specification paragraph number and generic name of each item.

3. Web-Based Project Management Software: Prepare submittals in PDF form, and upload to web-based Project software website. Enter required data in web-based software site to fully identify submittal.
4. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.

    a. Samples that may be incorporated into the Work are indicated in individual Specification Sections. Such Samples must be in an undamaged condition at time of use.
    b. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.

5. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units, showing the full range of colors, textures, and patterns available.

a. Number of Samples: Submit one full set(s) of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Architect will return submittal with options selected.

6. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.

   a. Number of Samples: Submit four sets of Samples. Architect will each retain two Sample sets; remainder will be returned. Mark up and retain one returned Sample set as a project record Sample.

      1) Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.
      2) If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample, submit at least four sets of paired units that show approximate limits of variations.

D. Product Schedule: As required in individual Specification Sections, prepare a written summary indicating types of products required for the Work and their intended location. Include the following information in tabular form:

1. Type of product. Include unique identifier for each product indicated in the Contract Documents or assigned by Contractor if none is indicated.
2. Manufacturer and product name, and model number if applicable.
3. Number and name of room or space.
4. Location within room or space.

E. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, contact information of architects and owners, and other information specified.

F. Design Data: Prepare and submit written and graphic information indicating compliance with indicated performance and design criteria in individual Specification Sections. Include list of assumptions and summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Number each page of submittal.

G. Certificates:

1. Certificates and Certifications Submittals: Submit a statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity. Provide a notarized signature where indicated.
2. Installer Certificates: Submit written statements on manufacturer's letterhead, certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.

3. Manufacturer Certificates: Submit written statements on manufacturer's letterhead, certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.
4. Material Certificates: Submit written statements on manufacturer's letterhead, certifying that material complies with requirements in the Contract Documents.
5. Product Certificates: Submit written statements on manufacturer's letterhead, certifying that product complies with requirements in the Contract Documents.
6. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of AWS B2.1/B2.1M on AWS forms. Include names of firms and personnel certified.

H. Test and Research Reports:

1. Compatibility Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for substrate preparation and primers required.
2. Field Test Reports: Submit written reports indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.
3. Material Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.
4. Preconstruction Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.
5. Product Test Reports: Submit written reports indicating that current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.
6. Research Reports: Submit written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project. Include the following information:

    a. Name of evaluation organization.
    b. Date of evaluation.
    c. Time period when report is in effect.
    d. Product and manufacturers' names.
    e. Description of product.
    f. Test procedures and results.
    g. Limitations of use.

1.7 DELEGATED-DESIGN SERVICES

A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.

1. If criteria indicated are insufficient to perform services or certification required, submit a written request for additional information to Architect.

B. Delegated-Design Services Certification: In addition to Shop Drawings, Product Data, and other required submittals, submit digitally signed PDF file copies of certificate, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional.

1. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.

C. BIM Incorporation: Incorporate delegated-design drawing and data files into BIM established for Project.

1. Prepare delegated design drawings in the following format: Same digital data software program, version, and operating system as original Drawings.

1.8 CONTRACTOR'S REVIEW

A. Action Submittals and Informational Submittals: Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Architect.

B. Contractor's Approval: Indicate Contractor's approval for each submittal with a uniform approval stamp and indication in web-based Project management software. Include name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.

1. Architect will not review submittals received from Contractor that do not have Contractor's review and approval.

1.9 ARCHITECT'S REVIEW

A. Action Submittals: Architect will review each submittal, indicate corrections or revisions required, and return.

1. Electronic Submittals by Web-based Project Management Software: Architect will indicate, via markup on each submittal, the appropriate action and post to Project management software website.
2. Actions taken by indication on Project management software website have the following meanings:

a. REVIEWED, NO EXCEPTION TAKEN
b. REVIEWED, EXCEPTIONS NOTED, RESUBMISSION NOT REQUIRED
c. REVIEWED, EXCEPTIONS NOTED, RESUBMISSION REQUIRED
d. REJECTED, RESUBMISSION REQUIRED
e. NOT A REQUIRED SUBMITTAL
f. OTHER

B. Informational Submittals: Architect will review each submittal and will not return it or will return it if it does not comply with requirements. Architect will forward each submittal to appropriate party.

C. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from Architect.

D. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review.

E. Architect will discard submittals received from sources other than Contractor.

F. Submittals not required by the Contract Documents will be returned by Architect without action.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

This page is intentionally left blank.

SECTION 01 40 00 - QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for quality assurance and quality control.

B. Testing and inspection services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.

1. Specific quality-assurance and quality-control requirements for individual work results are specified in their respective Specification Sections. Requirements in individual Sections may also cover production of standard products.
2. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and quality-control procedures that facilitate compliance with the Contract Document requirements.
3. Requirements for Contractor to provide quality-assurance and quality-control services required by Architect, Owner, Commissioning Authority, or authorities having jurisdiction are not limited by provisions of this Section.

C. Related Requirements:

1. Section 01 43 39 “Mockups” for requirements related to integrated exterior mockups and room mockups.

1.2 DEFINITIONS

A. Experienced: When used with an entity or individual, "experienced," unless otherwise further described, means having successfully completed a minimum of five previous projects similar in nature, size, and extent to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.

B. Field Quality-Control Tests and Inspections: Tests and inspections that are performed on-site for installation of the Work and for completed Work.

C. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, subcontractor, or sub-subcontractor, to perform a particular construction operation, including installation, erection, application, assembly, and similar operations.

1. Use of trade-specific terminology in referring to a Work result does not require that certain construction activities specified apply exclusively to specific trade(s).

D. Mockups: Full-size physical assemblies that are constructed either as freestanding temporary built elements or as part of permanent construction. Mockups are constructed to verify selections made under Sample submittals; to demonstrate aesthetic effects and qualities of materials and execution; to review coordination, testing, or operation; to show interface between

dissimilar materials; and to demonstrate compliance with specified installation tolerances. Mockups are not Samples. Unless otherwise indicated, approved mockups establish the standard by which the Work will be judged.

1. Integrated Exterior Mockups: Mockups of the exterior envelope constructed on-site as freestanding temporary built elements, consisting of multiple products, assemblies, and subassemblies, with cutaways enabling inspection of concealed portions of the Work.

    a. Include each system, assembly, component, and part of the exterior wall and roof to be constructed for the Project. Colors of components shall be those selected by the Architect for use in the Project.

2. In-Place Mockups: Mockups constructed on-site in their actual final location as part of permanent construction.

E. Preconstruction Testing: Tests and inspections performed specifically for Project before products and materials are incorporated into the Work, to verify performance or compliance with specified criteria. Unless otherwise indicated, copies of reports of tests or inspections performed for other than the Project do not meet this definition.

F. Product Tests: Tests and inspections that are performed by a nationally recognized testing laboratory (NRTL) according to 29 CFR 1910.7, by a testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program (NVLAP), or by a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with specified requirements.

G. Source Quality-Control Tests and Inspections: Tests and inspections that are performed at the source (e.g., plant, mill, factory, or shop).

H. Testing Agency: An entity engaged to perform specific tests, inspections, or both. The term "testing laboratory" shall have the same meaning as the term "testing agency."

I. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work, to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.

J. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work, to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Contractor's quality-control services do not include contract administration activities performed by Architect.

1.3 DELEGATED-DESIGN SERVICES

A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.

1. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Architect.

B. Delegated-Design Services Statement: Submit a statement signed and sealed by the responsible design professional, for each product and system specifically assigned to

Contractor to be designed or certified by a design professional, indicating that the products and systems are in compliance with performance and design criteria indicated. Include list of codes, loads, and other factors used in performing these services.

C. The requirements for specific delegated-design services are included in the following technical specification Sections:

1. Section 03 10 00 “Concrete Formwork.”
2. Section 03 45 00 “Precast Architectural Concrete.”
3. Section 05 12 00 “Structural Steel.”
4. Section 05 40 00 “Cold-Formed Metal Framing.”
5. Section 05 50 00 “Metal Fabrications.”
6. Section 05 51 13 “Metal Pan Stairs.”
7. Section 05 51 19 “Metal Grating Stairs.”
8. Section 05 52 13 “Pipe and Tube Railings.”
9. Section 05 70 00 “Decorative Metal.”
10. Section 05 71 00 “Decorative Metal Stairs.”
11. Section 05 73 00 “Decorative Metal Railings.”
12. Section 05 73 13 “Glazed Decorative Metal Railings.”
13. Section 06 10 00 “Rough Carpentry.”
14. Section 06 83 13 “Fiber-Reinforced Plastic Paneling.”
15. Section 07 05 43.13 “Rainscreen Cladding Support.”
16. Section 07 84 13 “Penetration Firestopping.”
17. Section 07 84 43 “Joint Firestopping.”
18. Section 08 44 13 “Glazed Aluminum Curtain Walls.”
19. Section 08 56 53 “Security Windows.”
20. Section 08 63 00 “Metal-Framed Skylights.”
21. Section 08 80 00 “Glazing.”
22. Section 08 81 13 “Decorative Glass Glazing.”
23. Section 08 88 53 “Security Glazing.”
24. Section 08 91 19 “Fixed Louvers.”
25. Section 09 21 16.23 “Gypsum Board Shaft Wall Assemblies.”
26. Section 09 22 16 “Non-Structural Metal Framing.”
27. Section 09 75 13 “Stone Wall Facing.”
28. Section 10 14 00 “Signage.”
29. Section 10 21 13.17 “Phenolic-Core Toilet Compartments.”
30. Section 10 22 13 “Wire Mesh Partitions.”
31. Section 11 81 31 “Facility Fall Protection and Facade Access Equipment.”
32. Section 21 05 00 “Common Work Results for Fire Suppression.”
33. Section 21 13 00 “Fire Suppression Sprinkler Systems.”
34. Section 21 13 19 “Pre-Action Suppression Systems.”
35. Section 22 05 16 “Expansion Fittings and Loops for Plumbing.”
36. Section 22 05 29 “Hangers and Supports for Plumbing Piping and Equipment.”
37. Section 22 15 48.13 “Vibration Controls for Plumbing Piping and Equipment.”
38. Section 23 05 03 “Basic Mechanical Materials and Methods.”
39. Section 23 05 29 “Piping Supports and Anchors.”
40. Section 23 09 00 “Building Automation and Automatic Temperature Control Systems.”
41. Section 23 21 13 “Hydronic Piping.”
42. Section 23 23 00 “Refrigerant Piping.”
43. Section 26 05 33 “Raceways and Boxes.”
44. Section 27 41 00 “Audio Visual Systems.”
45. Section 28 46 00 “Addressable Fire Alarm System.”
46. Section 28 50 10 “Area of Rescue Assistance System.”

47. Section 28 50 20 “Emergency responder Radio System.”

1.4 CONFLICTING REQUIREMENTS

A. Conflicting Standards and Other Requirements: If compliance with two or more standards or requirements is specified and the standards or requirements establish different or conflicting requirements for minimum quantities or quality levels, inform the Architect regarding the conflict and obtain clarification prior to proceeding with the Work. Refer conflicting requirements that are different, but apparently equal, to Architect for clarification before proceeding.

1. In the absence of clarification from the Architect noted above, provide the greater quantity and higher quality indicated by the conflicting standards or requirements at no additional cost to the Owner.

B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Architect for a decision before proceeding.

1.5 ACTION SUBMITTALS

A. Mockup Shop Drawings: For integrated exterior mockups.

1. Include plans, sections, elevations, and details, indicating materials and size of mockup construction.
2. Indicate manufacturer and model number of individual components.
3. Provide axonometric drawings for conditions difficult to illustrate in two dimensions.

1.6 INFORMATIONAL SUBMITTALS

A. Contractor's Quality-Control Plan: For quality-assurance and quality-control activities and responsibilities.

B. Qualification Data: For Contractor's quality-control personnel.

C. Contractor's Statement of Responsibility: When required by authorities having jurisdiction, submit copy of written statement of responsibility submitted to authorities having jurisdiction before starting work on the following systems:

1. Seismic-force-resisting system, designated seismic system, or component listed in the Statement of Special Inspections
2. Primary wind-force-resisting system or a wind-resisting component listed in the Statement of Special Inspections.

D. Testing Agency Qualifications: For testing agencies specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.

E. Schedule of Tests and Inspections: Prepare in tabular form and include the following:

1. Specification Section number and title.
2. Entity responsible for performing tests and inspections.
3. Description of test and inspection.
4. Identification of applicable standards.
5. Identification of test and inspection methods.
6. Number of tests and inspections required.
7. Time schedule or time span for tests and inspections.
8. Requirements for obtaining samples.
9. Unique characteristics of each quality-control service.

F. Reports: Prepare and submit certified written reports and documents as specified.

G. Permits, Licenses, and Certificates: For Owner's record, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents established for compliance with standards and regulations bearing on performance of the Work.

1.7 CONTRACTOR'S QUALITY-CONTROL PLAN

A. Quality-Control Plan, General: Submit quality-control plan within 10 days of Notice to Proceed, and not less than five days prior to preconstruction conference. Submit in format acceptable to Architect. Identify personnel, procedures, controls, instructions, tests, records, and forms to be used to carry out Contractor's quality-assurance and quality-control responsibilities and to coordinate Owner's quality-assurance and quality-control activities. Coordinate with Contractor's Construction Schedule.

B. Quality-Control Personnel Qualifications: Engage qualified personnel trained and experienced in managing and executing quality-assurance and quality-control procedures similar in nature and extent to those required for Project.

1. Project quality-control manager may also serve as Project superintendent.

C. Submittal Procedure: Describe procedures for ensuring compliance with requirements through review and management of submittal process. Indicate qualifications of personnel responsible for submittal review.

D. Testing and Inspection: In quality-control plan, include a comprehensive schedule of Work requiring testing or inspection, including the following:

1. Contractor-performed tests and inspections, including subcontractor-performed tests and inspections. Include required tests and inspections and Contractor-elected tests and inspections. Distinguish source quality-control tests and inspections from field quality-control tests and inspections.
2. Special inspections required by authorities having jurisdiction and indicated on the Statement of Special Inspections.
3. Owner-performed tests and inspections indicated in the Contract Documents including, but not limited to, tests and inspections indicated to be performed by Commissioning Authority.

E. Continuous Inspection of Workmanship: Describe process for continuous inspection during construction to identify and correct deficiencies in workmanship in addition to testing and inspection specified. Indicate types of corrective actions to be required to bring the Work into compliance with standards of workmanship established by Contract requirements and approved mockups.

F. Monitoring and Documentation: Maintain testing and inspection reports, including log of approved and rejected results. Include Work Architect has indicated as nonconforming or defective. Indicate corrective actions taken to bring nonconforming Work into compliance with requirements. Comply with requirements of authorities having jurisdiction.

1.8 REPORTS AND DOCUMENTS

A. Test and Inspection Reports: Prepare and submit certified written reports specified in other Sections. Include the following:

1. Date of issue.
2. Project title and number.
3. Name, address, telephone number, and email address of testing agency.
4. Dates and locations of samples and tests or inspections.
5. Names of individuals making tests and inspections.
6. Description of the Work and test and inspection method.
7. Identification of product and Specification Section.
8. Complete test or inspection data.
9. Test and inspection results and an interpretation of test results.
10. Record of temperature and weather conditions at time of sample-taking and testing and inspection.
11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
12. Name and signature of laboratory inspector.
13. Recommendations on retesting and reinspecting.

B. Manufacturer's Technical Representative's Field Reports: Prepare written information documenting manufacturer's technical representative's tests and inspections specified in other Sections. Include the following:

1. Name, address, telephone number, and email address of technical representative making report.
2. Statement on condition of substrates and their acceptability for installation of product.
3. Statement that products at Project site comply with requirements.
4. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
5. Results of operational and other tests and a statement of whether observed performance complies with requirements.
6. Statement of whether conditions, products, and installation will affect warranty.
7. Other required items indicated in individual Specification Sections.

C. Factory-Authorized Service Representative's Reports: Prepare written information documenting manufacturer's factory-authorized service representative's tests and inspections specified in other Sections. Include the following:

1. Name, address, telephone number, and email address of factory-authorized service representative making report.
2. Statement that equipment complies with requirements.
3. Results of operational and other tests and a statement of whether observed performance complies with requirements.
4. Statement of whether conditions, products, and installation will affect warranty.
5. Other required items indicated in individual Specification Sections.

1.9 QUALITY ASSURANCE

A. Qualifications paragraphs in this article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.

B. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units. As applicable, procure products from manufacturers able to meet qualification requirements, warranty requirements, and technical or factory-authorized service representative requirements.

C. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

D. Installer Qualifications: A firm or individual experienced in installing, erecting, applying, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.

E. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that is similar in material, design, and extent to those indicated for this Project.

F. Specialists: Certain Specification Sections require that specific construction activities shall be performed by entities who are recognized experts in those operations. Specialists shall satisfy qualification requirements indicated and shall be engaged in the activities indicated.

1. Requirements of authorities having jurisdiction shall supersede requirements for specialists.

G. Testing and Inspecting Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspection indicated, as documented in accordance with ASTM E329, and with additional qualifications specified in individual Sections; and, where required by authorities having jurisdiction, that is acceptable to authorities.

H. Manufacturer's Technical Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to observe and inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

I. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect, demonstrate, repair, and

perform service on installations of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

J. Preconstruction Testing: Where testing agency is indicated to perform preconstruction testing for compliance with specified requirements for performance and test methods, comply with the following Contractor's responsibilities, including the following:

1. Provide test specimens representative of proposed products and construction.
2. Submit specimens in a timely manner with sufficient time for testing and analyzing results to prevent delaying the Work.
3. Provide sizes and configurations of test assemblies, mockups, and laboratory mockups to adequately demonstrate capability of products to comply with performance requirements.
4. Build site-assembled test assemblies and mockups, using installers who will perform same tasks for Project.
5. When testing is complete, remove test specimens and test assemblies, and mockups; do not reuse products on Project.
6. Testing Agency Responsibilities: Submit a certified written report of each test, inspection, and similar quality-assurance service to Architect and Commissioning Authority, with copy to Contractor. Interpret tests and inspections, and state in each report whether tested and inspected Work complies with or deviates from the Contract Documents.

K. Mockups: Before installing portions of the Work requiring mockups, build mockups for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work:

1. Build mockups of size indicated.
2. Build mockups in location indicated or, if not indicated, as approved by Architect.
3. Notify Architect seven days in advance of dates and times when mockups will be constructed.
4. Employ supervisory personnel who will oversee mockup construction. Employ workers who will be employed to perform same tasks during the construction at Project.
5. Demonstrate the proposed range of aesthetic effects and workmanship.
6. Obtain Architect's approval of mockups before starting corresponding Work, fabrication, or construction.

    a. Allow seven days for initial review and each re-review of each mockup.

7. Promptly correct unsatisfactory conditions noted by Architect's preliminary review, to the satisfaction of the Architect, before completion of final mockup.
8. Approval of mockups by the Architect does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
9. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
10. Demolish and remove mockups when directed unless otherwise indicated.

L. Specialty Mockups: See Section 014339 "Mockups" for additional construction requirements for integrated exterior mockups and room mockups.

1.10 QUALITY CONTROL

A. Owner Responsibilities: Where quality-control services are indicated as Owner's responsibility, Owner will engage a qualified testing agency to perform these services.

1. Owner will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of types of testing and inspection they are engaged to perform.
2. Costs for retesting and reinspecting construction that replaces or is necessitated by Work that failed to comply with the Contract Documents will be charged to Contractor, and the Contract Sum will be adjusted by Change Order.

B. Contractor Responsibilities: Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Perform additional quality-control activities, whether specified or not, to verify and document that the Work complies with requirements.

1. Unless otherwise indicated, provide quality-control services specified and those required by authorities having jurisdiction. Perform quality-control services required of Contractor by authorities having jurisdiction, whether specified or not.
2. Engage a qualified testing agency to perform quality-control services.

    a. Contractor shall not employ same entity engaged by Owner, unless agreed to in writing by Owner.

3. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspection will be performed.
4. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
5. Testing and inspection requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
6. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.

C. Retesting/Reinspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspecting, for construction that replaced Work that failed to comply with the Contract Documents.

D. Testing Agency Responsibilities: Cooperate with Architect, Commissioning Authority, and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.

1. Notify Architect, Commissioning Authority, and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
2. Determine the locations from which test samples will be taken and in which in-situ tests are conducted.
3. Conduct and interpret tests and inspections, and state in each report whether tested and inspected Work complies with or deviates from requirements.
4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
6. Do not perform duties of Contractor.

E. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing as specified in Section 01 33 00 "Submittal Procedures."

F. Manufacturer's Technical Services: Where indicated, engage a manufacturer's technical representative to observe and inspect the Work. Manufacturer's technical representative's services include participation in preinstallation conferences, examination of substrates and conditions, verification of materials, observation of Installer activities, inspection of completed portions of the Work, and submittal of written reports.

G. Contractor's Associated Requirements and Services: Cooperate with agencies and representatives performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:

1. Access to the Work.
2. Incidental labor and facilities necessary to facilitate tests and inspections.
3. Adequate quantities of representative samples of materials that require testing and inspection. Assist agency in obtaining samples.
4. Facilities for storage and field curing of test samples.
5. Delivery of samples to testing agencies.
6. Preliminary design mix proposed for use for material mixes that require control by testing agency.
7. Security and protection for samples and for testing and inspection equipment at Project site.

H. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and quality-control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspection.

1. Schedule times for tests, inspections, obtaining samples, and similar activities.

I. Schedule of Tests and Inspections: Prepare a schedule of tests, inspections, and similar quality-control services required by the Contract Documents as a component of Contractor’s Quality-Control Plan. Coordinate and submit concurrently with Contractor's Construction Schedule. Update and submit with each Application for Payment.

1. Schedule Contents: Include tests, inspections, and quality-control services, including Contractor- and Owner-retained services, commissioning activities, and other Project-required services paid for by other entities.
2. Distribution: Distribute schedule to Owner, Architect, Commissioning Authority, testing agencies, and each party involved in performance of portions of the Work where tests and inspections are required.

1.11 SPECIAL TESTS AND INSPECTIONS

A. Special Tests and Inspections: Owner will engage a qualified special inspector to conduct special tests and inspections required by authorities having jurisdiction as the responsibility of Owner, as indicated in the Statement of Special Inspections on the Drawing, and as follows:

1. Verifying that manufacturer maintains detailed fabrication and quality-control procedures and reviewing the completeness and adequacy of those procedures to perform the Work.
2. Notifying Architect, Commissioning Authority, and Contractor promptly of irregularities and deficiencies observed in the Work during performance of its services.
3. Submitting a certified written report of each test, inspection, and similar quality-control service to Architect and Commissioning Authority with copy to Contractor and to authorities having jurisdiction.
4. Submitting a final report of special tests and inspections at Substantial Completion, which includes a list of unresolved deficiencies.
5. Interpreting tests and inspections, and stating in each report whether tested and inspected Work complies with or deviates from the Contract Documents.
6. Retesting and reinspecting corrected Work.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 TEST AND INSPECTION LOG

A. Test and Inspection Log: Prepare a record of tests and inspections. Include the following:

1. Date test or inspection was conducted.
2. Description of the Work tested or inspected.
3. Date test or inspection results were transmitted to Architect.
4. Identification of testing agency or special inspector conducting test or inspection.

B. Maintain log at Project site. Post changes and revisions as they occur. Provide access to test and inspection log for Architect's, Commissioning Authority’s, and authorities' having jurisdiction reference during normal working hours.

1. Submit log at Project closeout as part of Project Record Documents.

3.2 REPAIR AND PROTECTION

A. General: On completion of testing, inspection, sample-taking, and similar services, repair damaged construction and restore substrates and finishes.

1. Provide materials and comply with installation requirements specified in other Specification Sections or matching existing substrates and finishes. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible. Comply with the Contract Document requirements for cutting and patching in Section 01 73 00 "Execution."

B. Protect construction exposed by or for quality-control service activities.

C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

END OF SECTION

SECTION 01 42 00 - REFERENCES

PART 1 - GENERAL

1.1 DEFINITIONS

A. General: Basic Contract definitions are included in the Conditions of the Contract.

B. "Approved": When used to convey Architect's action on Contractor's submittals, applications, and requests, "approved" is limited to Architect's duties and responsibilities as stated in the Conditions of the Contract.

C. "Directed": A command or instruction by Architect. Other terms including "requested," "authorized," "selected," "required," and "permitted" have the same meaning as "directed."

D. "Indicated": Requirements expressed by graphic representations or in written form on Drawings, in Specifications, and in other Contract Documents. Other terms including "shown," "noted," "scheduled," and "specified" have the same meaning as "indicated."

E. "Regulations": Laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, and rules, conventions, and agreements within the construction industry that control performance of the Work.

F. "Furnish": Supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.

G. "Install": Unload, temporarily store, unpack, assemble, erect, place, anchor, apply, work to dimension, finish, cure, protect, clean, and similar operations at Project site.

H. "Provide": Furnish and install, complete and ready for the intended use.

I. "Project Site": Space available for performing construction activities. The extent of Project site is shown on Drawings and may or may not be identical with the description of the land on which Project is to be built.

1.2 INDUSTRY STANDARDS

A. Applicability of Standards: Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference.

B. Publication Dates: Comply with standards in effect as of date of the Contract Documents unless otherwise indicated.

1. For standards referenced by applicable building codes, comply with dates of standards as listed in building codes.

C. Copies of Standards: Each entity engaged in construction on Project should be familiar with industry standards applicable to its construction activity. Copies of applicable standards are not bound with the Contract Documents.

1. Where copies of standards are needed to perform a required construction activity, obtain copies directly from publication source.

D. Abbreviations and Acronyms for Standards and Regulations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the standards and regulations in the following list.

1. ADAAG - Americans with Disabilities Act
2. ADA - Architectural Barriers Act (ABA)
3. CFR - Code of Federal Regulations
4. CRD - Handbook for Concrete and Cement
5. DOD - Department of Defense Military Specifications and Standards
6. DSCC - Defense Supply Center Columbus (See FS)
7. FED-STD - Federal Standard (See FS)
8. FS - Federal Specification
9. FTMS - Federal Test Method Standard (See FS)
10. ICC-ES - ICC Evaluation Service, Inc.
11. MIL - (See MILSPEC)
12. MIL-STD - (See MILSPEC)
13. MILSPEC - Military Specification and Standards
14. NES - National Evaluation Service (See ICC-ES)
15. UFAS - Uniform Federal Accessibility Standards

1.3 ABBREVIATIONS AND ACRONYMS

A. Industry Organizations, List: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they are to mean the recognized name of the entities in the following list. Abbreviations and acronyms not included in this list are to mean the recognized name of the entities indicated in Gale's "Encyclopedia of Associations: National Organizations of the U.S." or in Columbia Books' "National Trade & Professional Associations of the United States." The information in this list is subject to change and is believed to be accurate as of the date of the Contract Documents.

1. AABC - Associated Air Balance Council; www.aabc.com.
2. AAMA - American Architectural Manufacturers Association; (see FGIA).
3. AAPFCO - Association of American Plant Food Control Officials; www.aapfco.org.
4. AASHTO - American Association of State Highway and Transportation Officials; www.transportation.org.
5. AATCC - American Association of Textile Chemists and Colorists; www.aatcc.org.
6. ABMA - American Bearing Manufacturers Association; www.americanbearings.org.
7. ABMA - American Boiler Manufacturers Association; www.abma.com.
8. ACI - American Concrete Institute; www.concrete.org.
9. ACP - American Clean Power; (Formerly: American Wind Energy Association); www.cleanpower.org.
10. ACPA - American Concrete Pipe Association; www.concretepipe.org.
11. AEIC - Association of Edison Illuminating Companies, Inc. (The); www.aeic.org.
12. AF&PA - American Forest & Paper Association; www.afandpa.org.
13. AGA - American Gas Association; www.aga.org.

14. AHAM - Association of Home Appliance Manufacturers; www.aham.org.
15. AHRI - Air-Conditioning, Heating, and Refrigeration Institute (The); www.ahrinet.org.
16. AI - Asphalt Institute; www.asphaltinstitute.org.
17. AIA - American Institute of Architects (The); www.aia.org.
18. AISC - American Institute of Steel Construction; www.aisc.org.
19. AISI - American Iron and Steel Institute; www.steel.org.
20. AITC - American Institute of Timber Construction; (see PLIB).
21. AMCA - Air Movement and Control Association International, Inc.; www.amca.org.
22. AMPP - Association for Materials Protection and Performance; www.ampp.org.
23. ANSI - American National Standards Institute; www.ansi.org.
24. AOSA/SCST - Association of Official Seed Analysts (The)/Society of Commercial Seed Technologists (The); www.analyzeseeds.com.
25. APA - APA - The Engineered Wood Association; www.apawood.org.
26. APA - Architectural Precast Association; www.archprecast.org.
27. API - American Petroleum Institute; www.api.org.
28. ARMA - Asphalt Roofing Manufacturers Association; www.asphaltroofing.org.
29. ASA - Acoustical Society of America; www.acousticalsociety.org.
30. ASCE - American Society of Civil Engineers; www.asce.org.
31. ASCE/SEI - American Society of Civil Engineers/Structural Engineering Institute; (see ASCE).
32. ASHRAE - American Society of Heating, Refrigerating and Air-Conditioning Engineers; www.ashrae.org.
33. ASME - ASME International; American Society of Mechanical Engineers (The); www.asme.org.
34. ASSE - ASSE International; (American Society of Sanitary Engineering); www.asse-plumbing.org.
35. ASSP - American Society of Safety Professionals; www.assp.org.
36. ASTM - ASTM International; www.astm.org.
37. ATIS - Alliance for Telecommunications Industry Solutions; www.atis.org.
38. AVIXA - Audiovisual and Integrated Experience Association; www.avixa.org.
39. AWI - Architectural Woodwork Institute; www.awinet.org.
40. AWMAC - Architectural Woodwork Manufacturers Association of Canada; www.awmac.com.
41. AWPA - American Wood Protection Association; www.awpa.com.
42. AWS - American Welding Society; www.aws.org.
43. AWWA - American Water Works Association; www.awwa.org.
44. BHMA - Builders Hardware Manufacturers Association; www.buildershardware.com.
45. BIA - Brick Industry Association (The); www.gobrick.com.
46. BICSI - BICSI, Inc.; www.bicsi.org.
47. BIFMA - Business and Institutional Furniture Manufacturer's Association; www.bifma.org.
48. BISSC - Baking Industry Sanitation Standards Committee; www.bissc.org.
49. BWF - Badminton World Federation; www.bwfbadminton.com.
50. CARB - California Air Resources Board; www.arb.ca.gov.
51. CDA - Copper Development Association Inc.; www.copper.org.
52. CE - Conformite Europeenne (European Commission); www.ec.europa.eu/growth/single-market/ce-marking.
53. CEA - Canadian Electricity Association; www.electricity.ca.
54. CFFA - Chemical Fabrics and Film Association, Inc.; www.chemicalfabricsandfilm.com.
55. CFSEI - Cold-Formed Steel Engineers Institute; www.cfsei.org.
56. CGA - Compressed Gas Association; www.cganet.com.
57. CIMA - Cellulose Insulation Manufacturers Association; www.cellulose.org.
58. CISCA - Ceilings & Interior Systems Construction Association; www.cisca.org.
59. CISPI - Cast Iron Soil Pipe Institute; www.cispi.org.

60. CLFMI - Chain Link Fence Manufacturers Institute; www.chainlinkinfo.org.
61. CPA - Composite Panel Association; www.compositepanel.org.
62. CRI - Carpet and Rug Institute (The); www.carpet-rug.org.
63. CRRC - Cool Roof Rating Council; www.coolroofs.org.
64. CRSI - Concrete Reinforcing Steel Institute; www.crsi.org.
65. CSA - CSA Group; www.csagroup.org.
66. CSI - Cast Stone Institute; www.caststone.org.
67. CSI - Construction Specifications Institute (The); www.csiresources.org.
68. CSSB - Cedar Shake & Shingle Bureau; www.cedarbureau.org.
69. CTA - Consumer Technology Association; www.cta.tech.
70. CTI - Cooling Technology Institute; www.coolingtechnology.org.
71. DASMA - Door and Access Systems Manufacturers Association; www.dasma.com.
72. DHA - Decorative Hardwoods Association; www.decorativehardwoods.org.
73. DHI - Door and Hardware Institute; www.dhi.org.
74. ECIA - Electronic Components Industry Association; www.ecianow.org.
75. EIMA - EIFS Industry Members Association; www.eima.com.
76. EJMA - Expansion Joint Manufacturers Association, Inc.; www.ejma.org.
77. EOS/ESD - EOS/ESD Association, Inc.; Electrostatic Discharge Association; www.esda.org.
78. ESTA - Entertainment Services and Technology Association; www.esta.org.
79. EVO - Efficiency Valuation Organization; www.evo-world.org.
80. FCI - Fluid Controls Institute; www.fluidcontrolsinstitute.org.
81. FGIA - Fenestration and Glazing Industry Alliance; https://fgiaonline.org.
82. FIBA - Federation Internationale de Basketball; (The International Basketball Federation); www.fiba.com.
83. FIVB - Federation Internationale de Volleyball; (The International Volleyball Federation); www.fivb.org.
84. FM Approvals - FM Approvals LLC; www.fmapprovals.com.
85. FM Global - FM Global; www.fmglobal.com.
86. FRSA - Florida Roofing and Sheet Metal Contractors Association, Inc.; www.floridaroof.com.
87. FSA - Fluid Sealing Association; www.fluidsealing.com.
88. FSC - Forest Stewardship Council U.S.; www.fscus.org.
89. GA - Gypsum Association; www.gypsum.org.
90. GS - Green Seal; www.greenseal.org.
91. HI - Hydraulic Institute; www.pumps.org.
92. HMMA - Hollow Metal Manufacturers Association; (see NAAMM).
93. IAPSC - International Association of Professional Security Consultants; www.iapsc.org.
94. IAS - International Accreditation Service; www.iasonline.org.
95. ICC - International Code Council; www.iccsafe.org.
96. ICEA - Insulated Cable Engineers Association, Inc.; www.icea.net.
97. ICPA - International Cast Polymer Association (The); www.theicpa.com.
98. ICRI - International Concrete Repair Institute, Inc.; www.icri.org.
99. IEC - International Electrotechnical Commission; www.iec.ch.
100. IEEE SA - IEEE Standards Association; https://standards.ieee.org.
101. IES - Illuminating Engineering Society; www.ies.org.
102. IEST - Institute of Environmental Sciences and Technology; www.iest.org.
103. IGMA - Insulating Glass Manufacturers Alliance; (see FGIA).
104. IGSHPA - International Ground Source Heat Pump Association; www.igshpa.org.
105. ILI - Indiana Limestone Institute of America, Inc.; www.iliai.com.
106. Intertek - Intertek Group; www.intertek.com.
107. ISA - International Society of Automation (The); www.isa.org.
108. ISFA - International Surface Fabricators Association; www.isfanow.org.

109. ISO - International Organization for Standardization; www.iso.org.
110. ITU - International Telecommunication Union; www.itu.int.
111. KCMA - Kitchen Cabinet Manufacturers Association; www.kcma.org.
112. LPI - Lightning Protection Institute; www.lightning.org.
113. MBMA - Metal Building Manufacturers Association; www.mbma.com.
114. MCA - Metal Construction Association; www.metalconstruction.org.
115. MFMA - Maple Flooring Manufacturers Association, Inc.; www.maplefloor.org.
116. MFMA - Metal Framing Manufacturers Association, Inc.; www.metalframingmfg.org.
117. MHI - Material Handling Industry; www.mhi.org.
118. MMPA - Moulding & Millwork Producers Association; www.wmmpa.com.
119. MPI - Master Painters Institute; www.paintinfo.com.
120. MSS - Manufacturers Standardization Society of The Valve and Fittings Industry, Inc.; www.msshq.org.
121. NAAMM - National Association of Architectural Metal Manufacturers; www.naamm.org.
122. NACE - NACE International; (National Association of Corrosion Engineers International); (see AMPP).
123. NADCA - National Air Duct Cleaners Association; www.nadca.com.
124. NAIMA - North American Insulation Manufacturers Association; www.insulationinstitute.org.
125. NALP - National Association of Landscape Professionals; www.landscapeprofessionals.org.
126. NBGQA - National Building Granite Quarries Association, Inc.; www.nbgqa.com.
127. NBI - New Buildings Institute; www.newbuildings.org.
128. NCAA - National Collegiate Athletic Association (The); www.ncaa.org.
129. NCMA - National Concrete Masonry Association; www.ncma.org.
130. NEBB - National Environmental Balancing Bureau; www.nebb.org.
131. NECA - National Electrical Contractors Association; www.necanet.org.
132. NeLMA - Northeastern Lumber Manufacturers Association; www.nelma.org.
133. NEMA - National Electrical Manufacturers Association; www.nema.org.
134. NETA - InterNational Electrical Testing Association; www.netaworld.org.
135. NFHS - National Federation of State High School Associations; www.nfhs.org.
136. NFPA - National Fire Protection Association; www.nfpa.org.
137. NFPA - NFPA International; (see NFPA).
138. NFRC - National Fenestration Rating Council; www.nfrc.org.
139. NGA - National Glass Association; www.glass.org.
140. NHLA - National Hardwood Lumber Association; www.nhla.com.
141. NLGA - National Lumber Grades Authority; www.nlga.org.
142. NOFMA - National Oak Flooring Manufacturers Association; (see NWFA).
143. NOMMA - National Ornamental & Miscellaneous Metals Association; www.nomma.org.
144. NRCA - National Roofing Contractors Association; www.nrca.net.
145. NRMCA - National Ready Mixed Concrete Association; www.nrmca.org.
146. NSF - NSF International; www.nsf.org.
147. NSI - Natural Stone Institute; www.naturalstoneinstitute.org.
148. NSPE - National Society of Professional Engineers; www.nspe.org.
149. NSSGA - National Stone, Sand & Gravel Association; www.nssga.org.
150. NTMA - National Terrazzo & Mosaic Association, Inc. (The); www.ntma.com.
151. NWFA - National Wood Flooring Association; www.nwfa.org.
152. NWRA - National Waste & Recycling Association; www.wasterecycling.org.
153. PCI - Precast/Prestressed Concrete Institute; www.pci.org.
154. PDI - Plumbing & Drainage Institute; www.pdionline.org.
155. PLASA - PLASA; www.plasa.org.
156. PLIB - Pacific Lumber Inspection Bureau; www.plib.org.
157. PVCPA - Uni-Bell PVC Pipe Association; www.uni-bell.org.

158. RCSC - Research Council on Structural Connections; www.boltcouncil.org.
159. RFCI - Resilient Floor Covering Institute; www.rfci.com.
160. RIS - Redwood Inspection Service; (see WWPA).
161. SAE - SAE International; www.sae.org.
162. SCTE - Society of Cable Telecommunications Engineers; www.scte.org.
163. SDI - Steel Deck Institute; www.sdi.org.
164. SDI - Steel Door Institute; www.steeldoor.org.
165. SEFA - Scientific Equipment and Furniture Association (The); www.sefalabs.com.
166. SEI/ASCE - Structural Engineering Institute/American Society of Civil Engineers; (see ASCE).
167. SIA - Security Industry Association; www.securityindustry.org.
168. SJI - Steel Joist Institute; www.steeljoist.org.
169. SMA - Screen Manufacturers Association; www.smainfo.org.
170. SMACNA - Sheet Metal and Air Conditioning Contractors' National Association; www.smacna.org.
171. SMPTE - Society of Motion Picture and Television Engineers; www.smpte.org.
172. SPFA - Spray Polyurethane Foam Alliance; www.sprayfoam.org.
173. SPIB - Southern Pine Inspection Bureau; www.spib.org.
174. SPRI - Single Ply Roofing Industry; www.spri.org.
175. SRCC - Solar Rating & Certification Corporation; www.solar-rating.org.
176. SSINA - Specialty Steel Industry of North America; www.ssina.com.
177. SSPC - SSPC: The Society for Protective Coatings; (see AMPP).
178. STI/SPFA - Steel Tank Institute/Steel Plate Fabricators Association; www.steeltank.com.
179. SWI - Steel Window Institute; www.steelwindows.com.
180. SWPA - Submersible Wastewater Pump Association; www.swpa.org.
181. TCA - Tilt-Up Concrete Association; www.tilt-up.org.
182. TCNA - Tile Council of North America, Inc.; www.tcnatile.com.
183. TEMA - Tubular Exchanger Manufacturers Association, Inc.; www.kbcdco.tema.org.
184. TIA - Telecommunications Industry Association (The); www.tiaonline.org.
185. TMS - The Masonry Society; www.masonrysociety.org.
186. TPI - Truss Plate Institute; www.tpinst.org.
187. TPI - Turfgrass Producers International; www.turfgrasssod.org.
188. TRI - Tile Roofing Industry Alliance; www.tileroofing.org.
189. ULSE - UL Standards & Engagement Inc.; www.ulse.org.
190. UL - UL Solutions Inc.; www.ul.com.
191. USAV - USA Volleyball; www.usavolleyball.org.
192. USGBC - U.S. Green Building Council; www.usgbc.org.
193. USITT - United States Institute for Theatre Technology, Inc.; www.usitt.org.
194. WA - Wallcoverings Association; www.wallcoverings.org.
195. WCLIB - West Coast Lumber Inspection Bureau; (see PLIB).
196. WCMA - Window Covering Manufacturers Association; www.wcmanet.org.
197. WDMA - Window & Door Manufacturers Association; www.wdma.com.
198. WI - Woodwork Institute; www.woodworkinstitute.com.
199. WSRCA - Western States Roofing Contractors Association; www.wsrca.com.
200. WWPA - Western Wood Products Association; www.wwpa.org.

B. Code Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. This information is believed to be accurate as of the date of the Contract Documents.

1. IAPMO - International Association of Plumbing and Mechanical Officials; www.iapmo.org.
2. ICC - International Code Council; www.iccsafe.org.
3. ICC-ES - ICC Evaluation Service, LLC; www.icc-es.org.

C. Federal Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Information is subject to change and is up to date as of the date of the Contract Documents.

1. CPSC - U.S. Consumer Product Safety Commission; www.cpsc.gov.
2. DOC - U.S. Department of Commerce; www.commerce.gov.
3. DOD - U.S. Department of Defense; www.defense.gov.
4. DOE - U.S. Department of Energy; www.energy.gov.
5. DOJ - U.S. Department of Justice; www.ojp.usdoj.gov
6. DOS - U.S. Department of State; www.state.gov.
7. EPA - United States Environmental Protection Agency; www.epa.gov.
8. FAA - Federal Aviation Administration; www.faa.gov.
9. GPO - U.S. Government Publishing Office; www.gpo.gov.
10. GSA - U.S. General Services Administration; www.gsa.gov.
11. HUD - U.S. Department of Housing and Urban Development; www.hud.gov.
12. LBNL - Lawrence Berkeley National Laboratory; Energy Technologies Area; www.lbl.gov/.
13. NIST - National Institute of Standards and Technology; www.nist.gov.
14. OSHA - Occupational Safety & Health Administration; www.osha.gov.
15. TRB - Transportation Research Board; National Cooperative Highway Research Program; The National Academies; www.trb.org.
16. USACE - U.S. Army Corps of Engineers; www.usace.army.mil.
17. USDA - U.S. Department of Agriculture; Agriculture Research Service; U.S. Salinity Laboratory; www.ars.usda.gov.
18. USDA - U.S. Department of Agriculture; Rural Utilities Service; www.usda.gov.
19. USP - U.S. Pharmacopeial Convention; www.usp.org.
20. USPS - United States Postal Service; www.usps.com.

D. Standards and Regulations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the standards and regulations in the following list. This information is subject to change and is believed to be accurate as of the date of the Contract Documents.

1. CFR - Code of Federal Regulations; Available from U.S. Government Publishing Office; www.govinfo.gov.
2. DOD - U.S. Department of Defense; Military Specifications and Standards; Available from DLA Document Services; www.dsp.dla.mil/Specs-Standards/.
3. DSCC - Defense Supply Center Columbus; (see FS).
4. FED-STD - Federal Standard; (see FS).
5. FS - Federal Specification; Available from DLA Document Services; www.dsp.dla.mil/Specs-Standards/.
    a. Available from Defense Standardization Program; www.dsp.dla.mil.
    b. Available from U.S. General Services Administration; www.gsa.gov.
    c. Available from National Institute of Building Sciences/Whole Building Design Guide; www.wbdg.org.
6. MILSPEC - Military Specifications and Standards; (see DOD).
7. USAB - United States Access Board; www.access-board.gov.
8. USATBCB - U.S. Architectural & Transportation Barriers Compliance Board; (see USAB).

E. State Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list.

1. DGS - Department of General Services
2. DLLR - Department of Licensing and Labor Regulation
3. DNR - Department of Natural Resources
4. MDARNG - Maryland Army National Guard
5. MDE - Maryland Department of the Environment
6. MDOT - Maryland Department of Transportation
7. SHA - State Highway Administration

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

SECTION 01 43 39 - MOCKUPS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Integrated exterior mockups.
2. Room mockups.

B. Related Requirements:

1. Section 01 40 00 "Quality Requirements" for quality assurance requirements for aesthetic and workmanship mockups specified in other Sections.

1.2 DEFINITIONS

A. Integrated Exterior Mockups: Mockups of the exterior envelope constructed on-site as freestanding temporary built elements, consisting of multiple products, assemblies, and subassemblies.

B. Room Mockups: Mockups of interior spaces constructed off-site. Mockup to include shell of room with

C. complete with wall, floor, and ceiling finishes; doors; windows; millwork; casework; specialties; furnishings and equipment; and lighting as indicated.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Meet with Owner, Architect, testing and inspecting agency representative, and installers of major systems whose Work is included in integrated exterior and room mockups.
2. Review coordination of equipment and furnishings provided by the Owner for room mockups.
3. Review locations and extent of mockups.
4. Review and finalize schedule for mockups, and verify availability of materials, personnel, equipment, and facilities needed to complete mockups and testing and maintain schedule for the Work.

1.4 ACTION SUBMITTALS

A. Shop Drawings: For integrated exterior and room mockups.

1. Include floor plans, reflected ceiling plans, elevations, sections, proposed lighting, and millwork details.
2. Include site location drawing indicating orientation of mockup.
3. Revise and resubmit Shop Drawings to reflect approved modifications in details and component interfaces resulting from changes made during testing procedures.

B. Delegated Design Submittal: For temporary structural supports for mockups not attached to building structure, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 QUALITY ASSURANCE

A. Build mockups to do the following:

1. Verify selections made under Sample submittals.
2. Demonstrate aesthetic effects.
3. Demonstrate the qualities of products and workmanship.
4. Demonstrate acceptable coordination between components and systems.
5. Perform preconstruction testing, such as window air- and water-leakage testing.

B. Fabrication: Before fabricating or installing portions of the Work requiring mockups, build mockups for each form of construction and finish required. Use materials and installation methods as required for the Work.

1. Build mockups of size indicated.
2. Build mockups in location indicated or, if not indicated, as directed by Architect.
3. Employ supervisory personnel who will oversee mockup construction. Employ workers who will be employed to perform same tasks during the construction at Project.
4. Demonstrate the proposed range of aesthetic effects and workmanship.
5. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
6. Demolish and remove mockups when directed unless otherwise indicated.

C. Notifications:

1. Notify Architect seven days in advance of the dates and times when mockups will be constructed.
2. Allow seven days for initial review and each re-review of each mockup.

D. Approval: Obtain Architect's approval of mockups before starting fabrication or construction of corresponding Work.

1. Unless otherwise indicated, approved mockups establish the standard by which the Work will be judged.
2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

1.6 COORDINATION

A. Coordinate schedule for construction of mockups, so construction, testing, and review of mockups do not impact Project schedule.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design support structure for free-standing mockups.

B. Structural Performance:

1. Wind Loads: As indicated on Drawings.

C. Mockup Testing Performance Requirements: Perform tests using design pressures and performance criteria indicated for assemblies and products that are specified in other Sections and incorporated into integrated exterior mockups.

2.2 INTEGRATED EXTERIOR MOCKUPS

A. Construct integrated exterior mockups as indicated on Drawings and according to approved mockup Shop Drawings. Construct mockups to demonstrate constructability, coordination of trades, and sequencing of Work; and to ensure materials, components, subassemblies, assemblies, and interfaces integrate into a system complying with indicated performance and aesthetic requirements.

B. Design and construct foundation and superstructure to support free-standing integrated exterior mockups.

C. Build integrated exterior mockups using installers and construction methods that will be used in completed construction.

D. Use specified products that have been approved by Architect. Coordinate installation of materials and products specified in individual Specification Sections that include Work included in integrated exterior mockups.

E. Coordinate construction of the mockup to allow observation of air barrier installation, flashings, air barrier integration with fenestration systems, and other portions of the building air/moisture barrier and drainage assemblies, prior to installation of veneer, cladding elements, and other components that will obscure the work.

F. Retain approved mockups constructed in place. Incorporate fully into the Work.

2.3 ROOM MOCKUPS

A. Build room mockups as indicated and according to approved mockup Shop Drawings to evaluate courtroom space, sightlines, Judge's bench configuration, and courtroom functionality. Provide room mockups of the following rooms:

1. Court of Special Appeals – Small Courtroom, Room 4210

B. The Work of room mockups includes, but is not limited to, the following:

1. Millwork and casework constructed of plywood including:

a. Judge's Bench.
b. Attorney Tables.
c. Speaker Podium.
d. Spectator Rail.

2. Doors and frames.
3. Gypsum board walls and ceilings to represent final space configuration. Crown moldings and other ornamental trim are not required.
4. Lighting to simulate light levels in finished courtroom.

PART 3 - EXECUTION

3.1 TESTING OF INTEGRATED EXTERIOR MOCKUPS

A. Integrated Exterior Mockup Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

1. Testing and inspecting agency will interpret tests and state in each report whether tested Work complies with or deviates from requirements.

B. Integrated Exterior Mockup Testing Services: Perform the following tests in the following order:

1. Air Leakage: Test in accordance with ASTM E783 at 1.5 times the rate specified in "Mockup Testing Performance Requirements" Paragraph in "Performance Requirements" Article, but not more than 0.09 cfm/sq. ft. at a static-air-pressure differential of 6.24 lbf/sq. ft..

a. Perform a minimum of one test in areas as directed by Architect.

2. Water Penetration: Test in accordance with ASTM E1105 at a minimum uniform static-air-pressure differential of 0.67 times the static-air-pressure differential specified for laboratory testing in "Mockup Testing Performance Requirements" Paragraph in "Performance Requirements" Article, but not less than 6.24 lbf/sq. ft., and verify no evidence of water penetration.

C. Integrated exterior mockup will be considered defective if it does not pass tests and inspections.

END OF SECTION

SECTION 01 50 00 - TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes requirements for temporary utilities, support facilities, and security and protection facilities.

B. Related Requirements:

1. Section 01 33 00 “Submittal Procedures” for submitting copies of implementation and termination schedule and utility reports.
2. Section 01 50 10 “Temporary Facilities and Controls - State Field Office for Capital Improvement Projects” for requirements for provision of an exclusive field office for the State.
3. Section 02 41 19 “Selective Demolition” for Contractor’s use of site, coordination with occupants, and work restrictions associated with the work of removal of historic courtroom at existing Supreme Court of Maryland building.
4. Section 01 77 00 “Closeout Procedures” for progress cleaning requirements.
5. Divisions 02 through 33 Sections for temporary heat, ventilation, and humidity requirements for products in those Sections.
6. Section 32 12 16 “Asphalt Paving” for construction and maintenance of asphalt paving for temporary roads and paved areas.
7. Section 32 13 13 “Concrete Paving” for construction and maintenance of cement concrete pavement for temporary roads and paved areas.

1.2 USE CHARGES

A. General: Cost or use charges for temporary facilities are not chargeable to the Owner or Architect and shall be included in the Contract Sum. Allow other entities engaged in the Project to use temporary services and facilities without cost, including, but not limited to the following:

1. Architect,
2. State personnel,
3. Resting agencies, and
4. Personnel of authorities having jurisdiction.

B. Sewer Service: Pay sewer-service use charges for sewer usage by all entities for construction operations.

C. Water Service: Pay water-service use charges, whether metered or otherwise, for water used by all entities engaged in construction activities at Project site.

D. Electric Power Service: Pay electric-power-service use charges, whether metered or otherwise, for electricity used by all entities engaged in construction activities at Project site.

1.3 INFORMATIONAL SUBMITTALS

A. Site Utilization Plan: Show temporary facilities, temporary utility lines and connections, staging areas, construction site entrances, vehicle circulation, and parking areas for construction personnel.

B. Implementation and Termination Schedule: Within 15 days of date established for commencement of the Work, submit schedule indicating implementation and termination dates of each temporary utility.

C. Project Identification and Temporary Signs: Show fabrication and installation details, including plans, elevations, details, layouts, typestyles, graphic elements, and message content.

D. Fire-Safety Program: Show compliance with requirements of NFPA 241 and authorities having jurisdiction. Indicate Contractor personnel responsible for management of fire-prevention program.

E. Moisture- and Mold-Protection Plan: Describe procedures and controls for protecting materials and construction from water absorption and damage and mold. Describe delivery, handling, storage, installation, and protection provisions for materials subject to water absorption or water damage.

1. Indicate procedures for discarding water-damaged materials, protocols for mitigating water intrusion into completed Work, and requirements for replacing water-damaged Work.
2. Indicate sequencing of work that requires water, such as sprayed fire-resistive materials, plastering, and terrazzo grinding, and describe plans for dealing with water from these operations. Show procedures for verifying that wet construction has dried sufficiently to permit installation of finish materials.
3. Indicate methods to be used to avoid trapping water in finished work.

F. Noise and Vibration Control Plan: Identify construction activities that may impact the occupancy and use of adjacent existing buildings, whether occupied by others, or occupied by Owner. Include the following:

1. Methods used to meet the goals and requirements of Owner.
2. Concrete cutting method(s) to be used.
3. Location of construction devices on the site.
4. Show compliance with the use and maintenance of quieted construction devices for the duration of the Project.
5. Indicate activities that may disturb building occupants and that are planned to be performed during non-standard working hours as coordinated with Owner.
6. Indicate locations of sensitive areas or other areas requiring special attention as identified by Owner. Indicate means for complying with Owner's requirements.

1.4 QUALITY ASSURANCE

A. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.

B. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.

1.5 PROJECT CONDITIONS

A. Temporary Use of Permanent Facilities: Engage Installer of each permanent service to assume responsibility for operation, maintenance, and protection of each permanent service during its use as a construction facility before Owner's acceptance, regardless of previously assigned responsibilities.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Chain-Link Fencing: Minimum 2-inch, 0.148-inch-thick, galvanized-steel, chain-link fabric fencing; minimum 6 feet high with galvanized-steel pipe posts; minimum 2-3/8-inch-OD line posts and 2-7/8-inch-OD corner and pull posts, with 1-5/8-inch-OD top rails with galvanized barbed-wire top strand.

B. Portable Chain-Link Fencing: Minimum 2-inch, 0.148-inch-thick, galvanized-steel, chain-link fabric fencing; minimum 6 feet high with galvanized-steel pipe posts; minimum 2-3/8-inch-OD line posts and 2-7/8-inch-OD corner and pull posts, with 1-5/8-inch-OD top and bottom rails. Provide concrete or galvanized-steel bases for supporting posts.

C. Fencing Windscreen Privacy Screen: Polyester fabric scrim with grommets for attachment to chain-link fence, sized to height of fence, in color selected by Architect from manufacturer's standard colors.

D. Wood Enclosure Fence: Plywood, 8 feet high, framed with four 2-by-4-inch rails, with preservative-treated wood posts spaced not more than 8 feet apart.

E. Polyethylene Sheet: Reinforced, fire-resistive sheet, 10-mil minimum thickness, with flame-spread rating of 15 or less in accordance with ASTM E84 and passing NFPA 701 Test Method 2.

F. Dust-Control Adhesive-Surface Walk-Off Mats: Provide mats, minimum 36 by 60 inches.

G. Insulation: Unfaced mineral-fiber blanket, manufactured from glass, slag wool, or rock wool; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively.

2.2 TEMPORARY FACILITIES

A. Field Offices, General: Prefabricated or mobile units with serviceable finishes, temperature controls, and foundations adequate for normal loading.

B. State Field Office: Provide field office for exclusive use of State personnel as specified in Section 01 50 10 “Temporary Facilities and Controls – State Field Office for Capital Improvement Projects.”

C. Common-Use Field Office: In addition to State Field Office, provide common-use field office of sufficient size to accommodate needs of construction personnel office activities and to accommodate Project meetings specified in other Division 01 Sections. Keep office clean and orderly. Furnish and equip offices as follows:

1. Furniture required for Project-site documents, including file cabinets, plan tables, plan racks, and bookcases.
2. Conference room of sufficient size to accommodate meetings of a minimum of 20 individuals. Provide electrical power service and 120-V ac duplex receptacles, with no fewer than three receptacles on each wall. Provide two 72-inch video display monitors and networked computer capable of hosting ZOOM or TEAMS meetings. Furnish room with conference table and chairs, and 4-foot by 8 foot tack and marker boards.
3. Include conference room telephone speaker system with 6 remote microphones.
4. Drinking water and private toilet.
5. Heating and cooling equipment necessary to maintain a uniform indoor temperature of 68 to 72 deg F.
6. Workstations: Provide two (2), 8- by 6-foot workstations with power and data ports for dedicated use by Design Team.
7. High-speed internet service: Provide minimum 100-Mbps upload and download speeds.
8. Electronic Communication Service: Provide secure WiFi wireless connection to internet with provisions for access by Design Team.
9. Printer: "All-in-one" unit equipped with printer server, combining color printing, photocopying, scanning, and faxing, or separate units for each of these three functions.
10. Large Format Printer: Capable of plotting 36 by 48-inch-wide drawings.
11. Lighting fixtures capable of maintaining average illumination of 20 fc at desk height.
12. If required, Design Team will provide their own server and computer workstations.

D. Storage and Fabrication Sheds: Provide sheds sized, furnished, and equipped to accommodate materials and equipment for construction operations.

1. Store combustible materials apart from building.

2.3 EQUIPMENT

A. Fire Extinguishers: Portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures.

B. HVAC Equipment: Unless Owner authorizes use of permanent HVAC system, provide vented, self-contained, liquid-propane-gas or fuel-oil heaters with individual space thermostatic control.

1. Use of gasoline-burning space heaters, open-flame heaters, or salamander-type heating units is prohibited.
2. Heating, Cooling, and Dehumidifying Units: Listed and labeled for type of fuel being consumed, by a qualified testing agency acceptable to authorities having jurisdiction, and marked for intended location and application.
3. Permanent HVAC System: If Owner authorizes use of permanent HVAC system for temporary use during construction, provide filter with MERV of 8 at each return-air grille in system and remove at end of construction and clean HVAC system as required in Section 01 77 00 “Closeout Procedures.”

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Locate facilities where they will serve Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required by progress of the Work.

B. Provide each facility ready for use when needed to avoid delay. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.

3.2 TEMPORARY UTILITY INSTALLATION

A. General: Install temporary service.

B. Sewers and Drainage: Provide temporary utilities to remove effluent lawfully.
   1. If sewers are available, provide temporary connections to remove effluent that can be discharged lawfully. If sewers are not available or cannot be used, provide drainage ditches, dry wells, stabilization ponds, and similar facilities. If neither sewers nor drainage facilities can be lawfully used for discharge of effluent, provide containers to remove and dispose of effluent off-site in a lawful manner.

      a. Filter out excessive soil, construction debris, chemicals, oils, and similar contaminants that might clog sewers or pollute waterways before discharge.
      b. Connect temporary sewers to municipal system as directed by sewer department officials.
      c. Maintain temporary sewers and drainage facilities in a clean, sanitary condition. After heavy use, restore normal conditions promptly.
      d. Provide temporary filter beds, settlement tanks, separators, and similar devices to purify effluent to levels acceptable to authorities having jurisdiction.

C. Water Service: Install water service and distribution piping in sizes and pressures adequate for construction until permanent water service is in use. Sterilize temporary water piping before use.

D. Sanitary Facilities: Provide temporary toilets, wash facilities, safety shower and eyewash facilities, and drinking water for use of construction personnel. Comply with requirements of authorities having jurisdiction for type, number, location, operation, and maintenance of fixtures and facilities.

   1. Use of Permanent Toilets: Use of Owner's new toilet facilities is not permitted.

E. Temporary Heating and Cooling: Provide temporary heating and cooling required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of low temperatures or high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed.

   1. Provide temporary dehumidification systems when required to reduce ambient and substrate moisture levels to level required to allow installation or application of finishes and their proper curing or drying.

F. Electric Power Service: Provide electric power service and distribution system of sufficient size, capacity, and power characteristics required for construction operations.

1. Install electric power service underground, unless otherwise indicated.

G. Lighting: Provide temporary lighting with local switching that provides adequate illumination for construction operations, observations, inspections, and traffic conditions.

1. Install and operate temporary lighting that fulfills security and protection requirements without operating entire system.
2. Install lighting for Project Identification Sign.

H. Telephone Service: Provide temporary telephone service in common-use facilities for use by all construction personnel. Install WiFi cell phone access equipment and one land-based telephone line(s) for each field office.

1. At each telephone, post a list of important telephone numbers.

a. Police and fire departments.
b. Ambulance service.
c. Contractor's home office.
d. Contractor's emergency after-hours telephone number.
e. Architect's office.
f. Engineers' offices.
g. Owner's office.
h. Principal subcontractors' field and home offices.

2. Provide superintendent with cellular telephone or portable two-way radio for use when away from the field office.

I. Electronic Communication Service: Provide secure WiFi wireless connection to internet with provisions for access by Architect and Owner.

3.3 SUPPORT FACILITIES INSTALLATION

A. General: Comply with the following:

1. Provide construction for temporary field offices, shops, and sheds located within construction area or within 30 feet of building lines that is noncombustible in accordance with ASTM E136. Comply with NFPA 241.
2. Maintain support facilities until Architect schedules Substantial Completion inspection. Remove before Substantial Completion. Personnel remaining after Substantial Completion will be permitted to use permanent facilities, under conditions acceptable to Owner.

B. Temporary Roads and Paved Areas: Construct and maintain temporary roads and paved areas adequate for construction operations. Locate temporary roads and paved areas within construction limits indicated on Drawings.

1. Coordinate elevations of temporary roads and paved areas with permanent roads and paved areas.

2. Prepare subgrade and install subbase and base for temporary roads and paved areas in accordance with Section 31 20 00 "Earth Moving."
3. Recondition base after temporary use, including removing contaminated material, regrading, proofrolling, compacting, and testing.
4. Delay installation of final course of permanent hot-mix asphalt pavement until immediately before Substantial Completion. Repair hot-mix asphalt base-course pavement before installation of final course in accordance with Section 32 12 16 "Asphalt Paving."
5. Provide dust-control treatment that is nonpolluting and nontracking. Reapply treatment as required to minimize dust.

C. Traffic Controls: Comply with requirements of authorities having jurisdiction.

1. Protect existing site improvements to remain, including curbs, pavement, and utilities.
2. Maintain access for fire-fighting equipment and access to fire hydrants.

D. Parking: Provide and identify a minimum of ten (10) reserved parking spaces for persons designated by the Owner for the duration of construction.

E. Dewatering Facilities and Drains: Comply with requirements of authorities having jurisdiction. Maintain Project site, excavations, and construction free of water.

1. Dispose of rainwater in a lawful manner that will not result in flooding Project or adjoining properties or endanger permanent Work or temporary facilities.
2. Remove snow and ice as required to minimize accumulations.

F. Project Identification and Temporary Signs: Prepare Project identification and other signs in accordance with the Department of General Services General Conditions. Install signs where indicated to inform public and persons seeking entrance to Project. Do not permit installation of unauthorized signs.

1. Provide temporary, directional signs for construction personnel and visitors.
2. Maintain and touchup signs so they are always legible.

G. Waste Disposal Facilities: Provide waste-collection containers in sizes adequate to handle waste from construction operations. Comply with requirements of authorities having jurisdiction. Comply with progress cleaning requirements in Section 01 73 00 "Execution."

H. Lifts and Hoists: Provide facilities necessary for hoisting materials and personnel.

I. Temporary Elevator Use: Refer to Section 14 21 23.16 “Machine Room-less Electric Traction Passenger Elevators” for temporary use of new elevators.

J. Temporary Stairs: Until permanent stairs are available, provide temporary stairs where ladders are not adequate.

K. Temporary Use of Permanent Stairs: Except for the lobby monumental stair, use of new stairs for construction traffic will be permitted, provided stairs are protected and finishes restored to new condition at time of Substantial Completion.

3.4 STATE FIELD OFFICE INSTALLATION

A. Refer to Section 01 50 10 “Temporary Facilities and Controls – State Field Office for Capital Improvement Projects.”

3.5 SECURITY AND PROTECTION FACILITIES INSTALLATION

A. Protection of Existing Facilities: Protect existing vegetation, equipment, structures, utilities, and other improvements at Project site and on adjacent properties, except those indicated to be removed or altered. Repair damage to existing facilities.

1. Where access to adjacent properties is required in order to affect protection of existing facilities, obtain written permission from adjacent property owner to access property for that purpose.

B. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction in ways and by methods that comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.

1. Comply with work restrictions specified in Section 01 10 00 “Summary.”

C. Temporary Erosion and Sedimentation Control: Provide measures to prevent soil erosion and discharge of soil-bearing water runoff and airborne dust to undisturbed areas and to adjacent properties and walkways, according to erosion- and sedimentation-control Drawings.

1. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross tree- or plant-protection zones.
2. Inspect, repair, and maintain erosion- and sedimentation-control measures during construction until permanent vegetation has been established.
3. Clean, repair, and restore adjoining properties and roads affected by erosion and sedimentation from Project site during the course of Project.
4. Remove erosion and sedimentation controls, and restore and stabilize areas disturbed during removal.

D. Stormwater Control: Comply with requirements of authorities having jurisdiction. Provide barriers in and around excavations and subgrade construction to prevent flooding by runoff of stormwater from heavy rains.

E. Tree and Plant Protection: Install temporary fencing located as indicated or outside the drip line of trees to protect vegetation from damage from construction operations. Protect tree root systems from damage, flooding, and erosion.

F. Pest Control: Engage pest-control service to recommend practices to minimize attraction and harboring of rodents, roaches, and other pests and to perform extermination and control procedures at regular intervals, so Project will be free of pests and their residues at Substantial Completion. Obtain extended warranty for Owner. Perform control operations lawfully, using environmentally safe materials.

G. Site Enclosure Fence: Before construction operations begin, furnish and install site enclosure fence in a manner that will prevent people and animals from easily entering site except by entrance gates.

1. Extent of Fence: As required to enclose entire Project site or portion determined sufficient to accommodate construction operations.
2. Maintain security by limiting number of keys and restricting distribution to authorized personnel. Furnish one set of keys to Owner.

H. Security Enclosure and Lockup: Install temporary enclosure around partially completed areas of construction. Provide lockable entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security. Lock entrances at end of each workday.

I. Security Detail: Provide on-site security personnel to monitor the entire construction site after hours and days in which the Contractor is not working on site.

J. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.

K. Covered Walkway: Erect protective, covered walkway for passage of individuals through or adjacent to Project site. Coordinate with entrance gates, other facilities, and obstructions. Comply with regulations of authorities having jurisdiction.

1. Provide overhead decking, protective enclosure walls, handrails, barricades, warning signs, exit signs, lights, safe and well-drained walkways, and similar provisions for protection and safe passage.
2. Paint and maintain appearance of walkway for duration of the Work.

L. Temporary Egress: Provide temporary egress from existing adjacent occupied facilities as indicated and as required by authorities having jurisdiction. Provide signage directing occupants to temporary egress.

M. Temporary Enclosures: Provide temporary enclosures for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. Provide temporary weathertight enclosure for building exterior.

1. Where heating or cooling is needed and permanent enclosure is incomplete, insulate temporary enclosures.

N. Temporary Fire Protection: Install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 241; manage fire-prevention program.

1. Prohibit smoking in construction areas. Comply with additional limits on smoking specified in other Sections.
2. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition in accordance with requirements of authorities having jurisdiction.
3. Develop and supervise an overall fire-prevention and -protection program for personnel at Project site. Review needs with local fire department and establish procedures to be followed. Instruct personnel in methods and procedures. Post warnings and information.
4. Provide temporary standpipes and hoses for fire protection. Hang hoses with a warning sign, stating that hoses are for fire-protection purposes only and are not to be removed. Match hose size with outlet size and equip with suitable nozzles.

3.6 MOISTURE AND MOLD CONTROL

A. Moisture and Mold Protection: Protect stored materials and installed Work in accordance with Moisture and Mold Protection Plan.

B. Exposed Construction Period: Before installation of weather barriers, when materials are subject to wetting and exposure and to airborne mold spores, protect as follows:

1. Protect porous materials from water damage.
2. Protect stored and installed material from flowing or standing water.
3. Keep porous and organic materials from coming into prolonged contact with concrete.
4. Remove standing water from decks.
5. Keep deck openings covered or dammed.

C. Partially Enclosed Construction Period: After installation of weather barriers but before full enclosure and conditioning of building, when installed materials are still subject to infiltration of moisture and ambient mold spores, protect as follows:

1. Do not load or install drywall or other porous materials or components, or items with high organic content, into partially enclosed building.
2. Keep interior spaces reasonably clean and protected from water damage.
3. Periodically collect and remove waste containing cellulose or other organic matter.
4. Discard or replace water-damaged material.
5. Do not install material that is wet.
6. Discard and replace stored or installed material that begins to grow mold.
7. Perform work in a sequence that allows wet materials adequate time to dry before enclosing the material in gypsum board or other interior finishes.

D. Controlled Construction Period: After completing and sealing of the building enclosure but prior to the full operation of permanent HVAC systems, maintain as follows:

1. Control moisture and humidity inside building by maintaining effective dry-in conditions.
2. Use temporary or permanent HVAC system to control humidity within ranges specified for installed and stored materials.
3. Comply with manufacturer's written instructions for temperature, relative humidity, and exposure to water limits.

    a. Hygroscopic materials that may support mold growth, including wood and gypsum-based products, that become wet during the course of construction and remain wet for 48 hours are considered defective and require replacing.
    b. Measure moisture content of materials that have been exposed to moisture during construction operations or after installation. Record readings beginning at time of exposure and continuing daily for 48 hours. Identify materials containing moisture levels higher than allowed. Report findings in writing to Architect.
    c. Remove and replace materials that cannot be completely restored to their manufactured moisture level within 48 hours.

3.7 OPERATION, TERMINATION, AND REMOVAL

A. Supervision: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.

B. Maintenance: Maintain facilities in good operating condition until removal.

1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.

C. Operate Project-identification-sign lighting daily from dusk until 12:00 A.M.

D. Temporary Facility Changeover: Do not change over from using temporary security and protection facilities to permanent facilities until Substantial Completion.

E. Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.

1. Materials and facilities that constitute temporary facilities are property of Contractor. Owner reserves right to take possession of Project identification signs.
2. Remove temporary paving not intended for or acceptable for integration into permanent paving. Where area is intended for landscape development, remove soil and aggregate fill that do not comply with requirements for fill or subsoil. Remove materials contaminated with road oil, asphalt and other petrochemical compounds, and other substances that might impair growth of plant materials or lawns. Repair or replace street paving, curbs, and sidewalks at temporary entrances, as required by authorities having jurisdiction.
3. At Substantial Completion, clean and renovate, and clean permanent facilities used during construction period. Comply with final cleaning requirements specified in Section 01 77 00 "Closeout Procedures."

END OF SECTION

This page is intentionally left blank.

SECTION 01 50 10 - TEMPORARY FACILITIES AND CONTROLS - STATE FIELD OFFICE FOR CAPITAL IMPROVEMENT PROJECTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes requirements for provision and maintenance of a field office for exclusive use of the State and its personnel.

B. Description of Work:

1. Provide one (1) prefabricated and completely finished temporary office trailer unit as approved by DGS Project Manager with lockable entrances and operable windows.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of equipment provided.

B. Shop Drawings: Of temporary office trailer.

1. Include plans, elevations, furniture and equipment layouts indicating compliance with requirements.

1.3 SCHEDULING

A. Provide a complete Owner’s Field Office facility in a location on the site as coordinated with the owner. Set up and make office ready for use promptly upon issuance of a Notice to Proceed (NTP) and at least seven (7) days prior to beginning any work on the contract.

PART 2 - PRODUCTS

2.1 TEMPORARY FACILITIES REQUIREMENTS

A. Field Office Area: Provide ADA accessible temporary field office with a minimum of 500 gross square feet of floor area.

B. Toilet Room:

1. Provide private ADA accessible toilet room with flush water closet, lavatory, mirror, medicine cabinet, paper towel and toilet paper dispensers.

C. Break Area:

1. Provide break area with a minimum of 8 lineal feet of countertop and base cabinets.

2. Provide wall cabinets above all base cabinets.
3. Provide sink, refrigerator, dishwasher, and countertop microwave oven.

D. Heating: Sized to provide a nominal 70 degrees F inside temperature under the ASHRAE winter outside design conditions applicable to the construction site location.

1. Provide distribution system sufficient for uniform heating and comfort.

E. Ventilation: Mechanical type sufficient for comfort during the change between heating and cooling seasons.

F. Air-Conditioning: System sufficient to maintain a nominal 80 degree F inside temperature under ASHRAE summer outside conditions applicable to the construction site location.

G. Alternative Space Conditioning Equipment: Provide the equivalent heating, ventilation, and air conditioning in a single combination unit or in other combinations.

H. Electrical Service: Service and service entrance complying with NFPA 70 and the following:

1. Provide one (1) duplex convenience outlet for each 150 square feet of floor space with a minimum of four (4) duplex convenience outlets.
2. Provide additional outlets and circuits as required for water cooler, refrigerator, microwave, dishwasher, air conditioning, and heating units.
3. Provide one (1) smoke detector.

I. Lighting:

1. Fluorescent lighting sufficient to provide a uniform distribution at the rate of 3 watts per square foot.
2. Illumination Level: Minimum 40 fc at work surfaces.

J. Equipment:

1. Electric Water Cooler and Water: Provide continuous delivery for the duration of the construction project of 5-gallon bottled water such as “Deer Park” or approved equal.
2. Portable Digital Wireless Phone:

    a. Equipment: Samsung Galaxy S21 Smartphone with Android operating system or Apple iPhone 15 with Apple iOS operating system, or better.
    b. Service Provider: Verizon with unlimited data plan.
    c. Service Duration: For duration of project until issuance of a Certificate of Final Completion.
    d. Protective Case: Otterbox Defender.
    e. Quantity: Two (2).
    f. Ownership: Phones will become the property of the State at the end of the Project.

3. Office Copier: Multi-function copier with print, fax, copy, and scan-to-email functionality.

    a. Provide maintenance and supplies, including ink and copy paper, for duration of the Project.
    b. Paper Sizes: Copier to accommodate trays for 8-1/2 x 11, 8-1/2 x 14, and 11 x 17 inch formats.

4. Wall Mounted Smart TV: Provide one (1) smart TV including mounting hardware and all necessary cables, complying with the following:

    a. Size: Minimum 55-inch.
    b. Interface: Cables and cable connectors for USB and HDMI connections from laptop computers.
    c. Location: Wall mounted in DGS-approved location to display drawings and pictures during project meetings.

5. Computers, Tablets, Printer and Accessories:

    a. Laptop Computers: Two (2) Dell Precision 5560 or newer model complying with the following or better:
        1) Processor: Intel Core i7-11850U; 8 core, 24 MB Cache, 2.5 GHz to 4.80 GHz, 45W, vPro or equal.
        2) Operating System: Windows 11 Professional.
        3) Video Card: NVIDIA T1200 with 4 GB.
        4) Display: 15.6 inch UltraSharp FHD+, 1920 x 1200, AG, NT, with Prem Panel Guar, 100% sRGB, Low BL with IR Camera.
        5) Memory: 16GB, 2 x 8 GB, DDR4, 3200MHz, Non-ECC, SODIMM.
        6) Hard Drive: M.2 5 2280 512 GB, Gen 3 PCIe x 4 NVMe, SED Solid State Drive.
        7) Wireless; Intel Dual Band Wireless AX201 2x2 + Bluetooth 5.2 vPro.
        8) Battery: 6 cell 86 Whr Lithium battery with Express Charge.
        9) Dell Thunderbolt Dock: WD19TBS.
        10) Warranty: Two years for parts and service with two years of at-site service with 24-hour response.

    b. Tablets: Two (2) Dell Latitude 7320 2-in-1 DTBL, XCTO or newer model complying with the following or better:

        1) Processor – 11th Generation Intel Core i7-1180G7; 4 Core, 12M cache, base 2.2Ghz, up to 4.63Ghz, vPro capable.
        2) Operating System: Windows 11 Professional.
        3) Memory: 16GB, LPDDR4X SDRAM, 4267 MHz (on board).
        4) Hard Drive – M.2 512GB PCIe NVMe Class 35 Solid State Drive.
        5) Display: LCD – 13” 3:2 FHD+ (1920 x 1280) Touch, 500 nits Super Low Power, Low Blue Light, Gorilla Glass 6 DX, Mic.
        6) Wireless: Intel Wi-Fi 6 AX201 2x2 802.11ax 160MHz + Bluetooth 5.2 Wireless Card.
        7) Mobile Broadband: Verizon MBB VRZN.
        8) Camera: RGB IR camera with Prox snsr (front).
        9) Detachable Keyboard: Dell Latitude Detachable Travel Keyboard.
        10) Pen: Dell Premium Active Pen
        11) Dell Thunderbolt Dock: WD19TBS.
        12) Support Service: Dell 4-year ProSupport Plan w/ Next Business Day Onsite Service; 2-year Extended Battery Service and 3-year Advanced Exchange Service
        13) Warranty: Two years for parts and service with two years of at-site service with 24-hour response.
        14) Internet Service: Service SIM card with Verizon as service provider.

    c. Apple iPads: Two (2) complying with the following:

1) Model: 12.9 inch iPad Pro with 512 GB, WiFi + Cellular with Verizon service.
2) Pencil: iPencil-2.

d. Surge Protectors:

1) Quantity: Seven and one for each laptop computer.
2) Cord Length: 6 feet.
3) Rating: 2160 Joules.

e. Software: For each device complying with the following:

1) Operating System: Windows 11 or most current version of Windows Professional; 64-bit.
2) Office Suite: Microsoft Office 365; most current full version.
3) PDF Reader and Editing Software: Adobe Acrobat Pro and Bluebeam REVU Core.
4) Scheduling: MS Project.
5) Anti-Virus Protection: McAfee.

f. Laptop and Tablet Accessories:

1) Docking Stations: Dell Thunderbolt Dock for each tablet and laptop.
2) Stylus Pen: One (1) for each Dell Latitude 2-in1 tablet.
3) Wireless Mouse and Keyboard: One (1) for each laptop, tablet, and PC.

a) Logitech MK345 (or newer) wireless combo; full-sized keyboard and mouse.
b) Detachable tablet keyboard for Dell Latitude 7320 2-in-1.

4) External Monitor:

a) Two (2) each: 24-inch, adjustable; Dell U2422H.
b) Two (2) each: 24-inch, web conferencing monitor; Dell C2422HE.

5) Flash Drive: One (1) 64GB.
6) Carrying Case: One (1) for each 17 inch laptop with shoulder strap; one for each tablet; and, one (1) for each mobile printer.
7) Protective Covers: For each tablet and iPad; Otterbox or equal.
8) Detachable Keyboard: Dell Latitude 7320; one (1) for each tablet.

g. Desktop Printer – Wireless:

1) Basis-of-Design Product: Subject to compliance with requirements, provide HP; LaserJet M479-FDN or a comparable product.
2) Type: Color, multi-function including printer, scanner, copier and fax.
3) Operation: Automatic two-sided (duplexing) for printing and copying.

h. Portable Printer:

1) Product: HP Officejet 250 Mobile All-in-One Printer or comparable newer product.
2) Functions: Capable of scanning, printing, and copying.

3) Warranty: Two-year warranty, parts, and service with two years of at-site service with 24-hour response.

i. General Requirements for Electronic Equipment:

1) Products indicated are the minimum standard.
2) Substitutions must be submitted and approved by DGS in writing.
3) All products to be provided with two-year warranty for parts, service and replacement with on-site service with 24-hours response time.
4) All equipment becomes the property of DGS at the end of the project.

6. First Aid Supplies: Provide in compliance with governing regulations.
7. Fire Extinguishers: Type ABC in number and rating and at locations in accordance with NFPA 10.
8. Hard Hats: Provide five (5) complying with OSHA standards.
9. Safety Vests: Provide five (5) high visibility vests complying with ANSI standards,
10. Office Accessories: Provide a minimum of the following:

1) Trash cans: Two (2).
2) File Folders: Four (4) boxes to commence project. Provide additional file folders as required for duration of Project.
3) Hanging File Folders: Four (4) boxes to commence project. Provide additional hanging file folders as required for duration of Project.
4) Standard stapler: One (1).
5) 3-Hole punch: One (1).
6) 2-hole punch: One (1).
7) Tape dispenser: One (1) with tape to be furnished for duration of the project.
8) Shredder: One (1), cross-cut type.
9) All office accessories becomes the property of DGS at the end of the project.

11. Internet Service: Provide internet service for the duration of the Project through Final Completion including the following:

1) Hard-wired WiFi router (802.11b/g/n) or wireless hot spot capable of supporting a minimum of 2 computers, with unlimited data, at a speed of at least 25Mbps.
2) Wireless (secured) Jetpack System for Owner shall have a minimum speed of 100 Mbps. Service provider shall be Verizon. Unless otherwise stated, the Wireless Jetpack shall become property of DGS at the end of the project.

K. Office Furnishings:

1. Desk: One (1), double pedestal desk with flat top; 30 by 60 inches.
2. Chairs: Two (2), heavy-duty computer chairs.
3. Conference Table: Suitable for seating 12 people.
4. Folding Chairs: Twelve (12).
5. File Cabinets: Two (2), metal, 4-drawer, legal size, with keyed locks, 27 inches deep with baked enamel finish. Provide keys to inspector.
6. Fireproof File Cabinet: One (1) heavy-duty, metal, 4-drawer, legal size, with keyed locks, 27 inches deep with backed enamel finish. Provide keys to inspector.
7. Shelving: For sample storage; two (2), ceiling-high units, 30 inches deep and minimum 3 feet wide with plywood sheets to close ends and backs.

8. Plan Racks: One (1) adjustable, aluminum rack capable of storing and provided with ten (10) sets of aluminum plan binders.

L. Window Shades: Manually operated roller shades at all windows.

M.

PART 3 - EXECUTION

3.1 OPERATION, TERMINATION, AND REMOVAL

A. Maintenance of Field Office: Maintain facilities in good operating condition until removal.

B. Maintenance of Equipment: Maintain and repair, as needed, all items indicated to be provided in this Section for the duration of the Contract. Replace items that cannot be satisfactorily repaired within two (2) working days.

C. Janitorial Service: Provide weekly janitorial service to always keep quarters of the State Representatives clean and neat.

D. Supplies: Ensure that office is always stocked with supplies including, but not limited to, paper towels, toilet paper, printer and copier ink and copy paper.

END OF SECTION

SECTION 01 56 39 - TEMPORARY TREE AND PLANT PROTECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes general protection and pruning of existing trees and plants that are affected by execution of the Work, whether temporary or permanent construction.

B. Related Requirements:

1. Section 015000 "Temporary Facilities and Controls" for temporary site fencing.
2. Section 311000 "Site Clearing" for removing existing trees and shrubs.

1.3 DEFINITIONS

A. Caliper (DBH): Diameter breast height; diameter of a trunk as measured by a diameter tape at a height 54 inches above the ground line for trees with caliper of 8 inches or greater as measured at a height of 12 inches above the ground.

B. Plant-Protection Zone: Area surrounding individual trees, groups of trees, shrubs, or other vegetation to be protected during construction and indicated on Drawings.

C. Tree-Protection Zone: Area surrounding individual trees or groups of trees to be protected during construction and indicated on Drawings.

D. Vegetation: Trees, shrubs, groundcovers, grass, and other plants.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review methods and procedures related to temporary tree and plant protection including, but not limited to, the following:

a. Tree-service firm's personnel, and equipment needed to make progress and avoid delays.
b. Arborist's responsibilities.
c. Quality-control program.
d. Coordination of Work and equipment movement with the locations of protection zones.
e. Trenching by hand or with air spade within protection zones.
f. Field quality control.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For arborist and tree service firm.

B. Certification: From arborist, certifying that trees indicated to remain have been protected during construction according to recognized standards and that trees were promptly and properly treated and repaired when damaged.

C. Maintenance Recommendations: From arborist, for care and protection of trees affected by construction during and after completing the Work.

D. Existing Conditions: Documentation of existing trees and plantings indicated to remain, which establishes preconstruction conditions that might be misconstrued as damage caused by construction activities.

1. Use sufficiently detailed photographs or video recordings.
2. Include plans and notations to indicate specific wounds and damage conditions of each tree or other plants designated to remain.

E. Quality-control program.

1.7 QUALITY ASSURANCE

A. Arborist Qualifications: For each applicable person expected to work on the project, provide copies of the qualifications and experience of the Consulting arborist, proof of either the registered Consulting Arborist® (RCA) with American Society of Consulting Arborists or an ISA Board Certified Master Arborist for review prior to the start of work.

B. Tree Service Firm Qualifications: An experienced tree service firm that has successfully completed temporary tree and plant protection work similar to that required for this Project and that will assign an experienced, qualified arborist to Project site during execution of the Work.

C. Quality-Control Program: Prepare a written program to systematically demonstrate the ability of personnel to properly follow procedures and handle materials and equipment during the Work without damaging trees and plantings. Include dimensioned diagrams for placement of protection zone fencing and signage, the arborist's and tree-service firm's responsibilities, instructions given to workers on the use and care of protection zones, and enforcement of requirements for protection zones.

1.8 FIELD CONDITIONS

A. The following practices are prohibited within protection zones:

1. Storage of construction materials, debris, or excavated material.
2. Moving or parking vehicles or equipment.
3. Foot traffic.
4. Erection of sheds or structures.
5. Impoundment of water.

6. Excavation or other digging unless otherwise indicated.
7. Attachment of signs to or wrapping materials around trees or plants unless otherwise indicated.

B. Do not direct vehicle or equipment exhaust toward protection zones.

C. Prohibit heat sources, flames, ignition sources, and smoking within or near protection zones and organic mulch.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Organic Mulch: Free from deleterious materials and suitable as a top dressing for trees and shrubs, consisting of one of the following:

1. Type: Shredded hardwood.
2. Size Range: 3 inches maximum, 1/2 inch minimum.
3. Color: Natural.

B. Protection-Zone Fencing: Fencing fixed in position and meeting the following requirements:

1. Wire Mesh Protection-Zone Fencing: 14 gauge 2”x4” welded wire fence, steel “T” bar or “U” channel posts spaced 10-ft apart with highly visible flagging, anchored to a depth of no less than 1/3 the total height of the post.

a. Height: 48 inches.

C. Protection-Zone Signage: Shop-fabricated, rigid plastic or metal sheet with attachment holes pre-punched and reinforced; legibly printed with nonfading lettering and as follows:

1. Size and Text: As shown on Drawings.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Erosion and Sedimentation Control: Examine the site to verify that temporary erosion- and sedimentation-control measures are in place. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross protection zones.

B. Prepare written report, endorsed by arborist, listing conditions detrimental to tree and plant protection.

3.2 PREPARATION

A. Locate and clearly identify trees, shrubs, and other vegetation to remain or to be relocated. Locate and clearly identify trees to be pruned as indicated in the drawings. Flag each tree trunk at 54 inches above the ground.

B. Map trees to be pruned and review with the Landscape Architect. Do not begin pruning without written approval from the Landscape Architect.

C. Protect tree root systems from damage caused by runoff or spillage of noxious materials while mixing, placing, or storing construction materials. Protect root systems from ponding, eroding, or excessive wetting caused by dewatering operations.

D. Tree-Protection Zones: Mulch areas inside tree-protection zones and other areas indicated. Do not exceed indicated thickness of mulch.

1. Apply 2-inch uniform thickness of organic mulch unless otherwise indicated. Do not place mulch within 6 inches of tree trunks.

E. Trunk Protection: Protect the trunk of each tree to remain as follows:

1. Install 2-by-4-inch wood planks around trunk at maximum 3 inches apart. Minimum three planks per tree. Band together with no less than three steel bands stapled to the planks to hold them securely in place.

a. Height: From root flare to approximately 8-feet from the ground or at the lowest existing branch.

3.3 PROTECTION ZONES

A. Protection-Zone Fencing: Install protection-zone fencing along edges of protection zones before materials or equipment are brought on the site and construction operations begin in a manner that will prevent people from easily entering protected areas except by entrance gates. Construct fencing so as not to obstruct safe passage or visibility at vehicle intersections where fencing is located adjacent to pedestrian walkways or in close proximity to street intersections, drives, or other vehicular circulation.

B. Protection-Zone Signage: Install protection-zone signage in visibly prominent locations in a manner approved by Architect.

C. Maintain protection zones free of weeds and trash.

D. Maintain protection-zone fencing and signage in good condition as acceptable to Architect and remove when construction operations are complete and equipment has been removed from the site.

1. Do not remove protection-zone fencing, even temporarily, to allow deliveries or equipment access through the protection zone.
2. Temporary access is permitted subject to preapproval in writing by arborist if a root buffer effective against soil compaction is constructed as directed by arborist. Maintain root buffer so long as access is permitted.

3.4 EXCAVATION

A. General: Excavate at edge of protection zones and for trenches indicated within protection zones according to requirements in Section 312000 "Earth Moving" unless otherwise indicated.

B. Trenching within Protection Zones: Where utility trenches are required within protection zones, excavate under or around tree roots by hand or with air spade, or tunnel under the roots by

drilling, auger boring, or pipe jacking. Do not cut main lateral tree roots or taproots; cut only smaller roots that interfere with installation of utilities. Cut roots as required for root pruning. If excavating by hand, use narrow-tine spading forks to comb soil and expose roots.

C. Redirect roots in backfill areas where possible. If encountering large, main lateral roots, expose roots beyond excavation limits as required to bend and redirect them without breaking. If encountered immediately adjacent to location of new construction and redirection is not practical, cut roots approximately 3 inches back from new construction and as required for root pruning.

D. Do not allow exposed roots to dry out before placing permanent backfill. Provide temporary earth cover or pack with peat moss and wrap with burlap. Water and maintain in a moist condition. Temporarily support and protect roots from damage until they are permanently relocated and covered with soil.

3.5 ROOT PRUNING

A. Prune tree roots that are affected by temporary and permanent construction. Prune roots as shown on Drawings.

3.6 CROWN PRUNING

A. Prune branches that are affected by temporary and permanent construction. Prune branches only as directed by arborist.

1. Prune to remove only injured, broken, dying, or dead branches unless otherwise indicated. Do not prune for shape unless otherwise indicated.
2. Prune trees along Rowe Boulevard and Farragut Road to prevent interference with vehicular traffic and to improve views through the trees into the site.
3. Prune trees designated on the drawings as CPTED to provide required 5 foot clearance in all directions.
4. Do not remove or reduce living branches to compensate for root loss caused by damaging or cutting root system.
5. Pruning Standards: Prune trees according to ANSI A300 (Part 1) and as indicated on Drawings.

B. Unless otherwise directed by arborist and acceptable to Landscape Architect, do not cut tree leaders.

C. Cut branches with sharp pruning instruments; do not break or chop.

D. Do not paint or apply sealants to wounds.

E. Provide subsequent maintenance pruning during Contract period as recommended by arborist.

F. Chip removed branches and dispose of off-site.

3.7 FIELD QUALITY CONTROL

A. Inspections: Engage a qualified arborist to direct plant-protection measures in the vicinity of trees, shrubs, and other vegetation indicated to remain and to prepare inspection reports.

3.8 REPAIR AND REPLACEMENT

A. General: Repair or replace trees, shrubs, and other vegetation indicated to remain or to be relocated that are damaged by construction operations, in a manner approved by Architect.

1. Submit details of proposed pruning and repairs.
2. Perform repairs of damaged trunks, branches, and roots within 24 hours according to arborist's written instructions.
3. Replace trees and other plants that cannot be repaired and restored to full-growth status, as determined by Architect.

B. Excess Mulch: Rake mulched area within protection zones, being careful not to injure roots. Rake to loosen and remove mulch that exceeds a 2-inch uniform thickness to remain.

3.9 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Disposal: Remove excess excavated material, displaced trees, trash, and debris and legally dispose of them off Owner's property.

END OF SECTION

SECTION 01 60 00 - PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. The Work of This Section Includes: Administrative and procedural requirements for selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; and comparable products.

B. Related Requirements:

1. Section 011000 "Summary" for Contractor requirements related to Owner-furnished products.
2. Section 012100 "Allowances" for products selected under an allowance.
3. Section 012300 "Alternates" for products selected under an alternate.
4. Section 012500 "Substitution Procedures" for requests for substitutions.
5. Section 014200 "References" for applicable industry standards for products specified.
6. Section 017700 "Closeout Procedures" for submitting warranties.

1.2 DEFINITIONS

A. Products: Items obtained for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.

1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation shown or listed in manufacturer's published product literature that is current as of date of the Contract Documents.
2. New Products: Items that have not previously been incorporated into another project or facility. Salvaged items or items reused from other projects are not considered new products. Items that are manufactured or fabricated to include recycled content materials are considered new products, unless indicated otherwise.
3. Comparable Product: Product by named manufacturer that is demonstrated and approved through the comparable product submittal process described in Part 2 "Comparable Products" Article, to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.

B. Basis-of-Design Product Specification: A specification in which a single manufacturer's product is named and accompanied by the words "basis-of-design product," including make or model number or other designation. Published attributes and characteristics of basis-of-design product establish salient characteristics of products.

1. Evaluation of Comparable Products: In addition to the basis-of-design product description, product attributes and characteristics may be listed to establish the significant qualities related to type, function, in-service performance and physical properties, weight, dimension, durability, visual characteristics, and other special features and requirements for purposes of evaluating comparable products of additional

manufacturers named in the specification. Manufacturer's published attributes and characteristics of basis-of-design product also establish salient characteristics of products for purposes of evaluating comparable products.

C. Subject to Compliance with Requirements: Where the phrase "Subject to compliance with requirements" introduces a product selection procedure in an individual Specification Section, provide products qualified under the specified product procedure. In the event that a named product or product by a named manufacturer does not meet the other requirements of the specifications, select another named product or product from another named manufacturer that does meet the requirements of the specifications; submit a comparable product request or substitution request, if applicable.

D. Comparable Product Request Submittal: An action submittal requesting consideration of a comparable product, including the following information:

1. Identification of basis-of-design product or fabrication or installation method to be replaced, including Specification Section number and title and Drawing numbers and titles.
2. Data indicating compliance with the requirements specified in Part 2 "Comparable Products" Article.

E. Basis-of-Design Product Specification Submittal: An action submittal complying with requirements in Section 01 33 00 "Submittal Procedures."

F. Substitution: Refer to Section 01 25 00 "Substitution Procedures" for definition and limitations on substitutions.

1.3 QUALITY ASSURANCE

A. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, select product compatible with products previously selected, even if previously selected products were also options.

B. Identification of Products: Except for required labels and operating data, do not attach or imprint manufacturer or product names or trademarks on exposed surfaces of products or equipment that will be exposed to view in occupied spaces or on the exterior.

1. Labels: Locate required product labels and stamps on a concealed surface, or, where required for observation following installation, on a visually accessible surface that is not conspicuous.
2. Equipment Nameplates: Provide a permanent nameplate on each item of service- or power-operated equipment. Locate on a visually accessible but inconspicuous surface. Include information essential for operation, including the following:

    a. Name of product and manufacturer.
    b. Model and serial number.
    c. Capacity.
    d. Speed.
    e. Ratings.

3. See individual identification Sections in Divisions 21, 22, 23, and 26 for additional equipment identification requirements.

1.4 COORDINATION

A. Modify or adjust affected work as necessary to integrate work of approved comparable products and approved substitutions.

1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle products, using means and methods that will prevent damage, deterioration, and loss, including theft and vandalism. Comply with manufacturer's written instructions.

B. Delivery and Handling:

1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.
2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
4. Inspect products on delivery to determine compliance with the Contract Documents and that products are undamaged and properly protected.

C. Storage:

1. Provide a secure location and enclosure at Project site for storage of materials and equipment.
2. Store products to allow for inspection and measurement of quantity or counting of units.
3. Store materials in a manner that will not endanger Project structure.
4. Store products that are subject to damage by the elements under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation and with adequate protection from wind.
5. Protect foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.
6. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
7. Protect stored products from damage and liquids from freezing.

1.6 PRODUCT WARRANTIES

A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.

1. Manufacturer's Warranty: Written standard warranty form furnished by individual manufacturer for a particular product and issued in the name of the Owner or endorsed by manufacturer to Owner.

2. Special Warranty: Written warranty required by the Contract Documents to provide specific rights for Owner and issued in the name of the Owner or endorsed by manufacturer to Owner.

B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution.

1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
2. Specified Form: When specified forms are included in the Project Manual, prepare a written document, using indicated form properly executed.
3. See other Sections for specific content requirements and particular requirements for submitting special warranties.

C. Submittal Time: Comply with requirements in Section 01 77 00 "Closeout Procedures."

PART 2 - PRODUCTS

2.1 PRODUCT SELECTION PROCEDURES

A. General Product Requirements: Provide products that comply with the Contract Documents, are undamaged and, unless otherwise indicated, are new at time of installation.

1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
3. Owner reserves the right to limit selection to products with warranties meeting requirements of the Contract Documents.
4. Where products are accompanied by the term "as selected," Architect will make selection.
5. Descriptive, performance, and reference standard requirements in the Specifications establish salient characteristics of products.
6. Or Equal: For products specified by name and accompanied by the term "or equal," "or approved equal," or "or approved," comply with requirements in "Comparable Products" Article to obtain approval for use of an unnamed product.

a. Submit additional documentation required by Architect in order to establish equivalency of proposed products. Unless otherwise indicated, evaluation of "or equal" product status is by the Architect, whose determination is final.

B. Product Selection Procedures:

1. Sole Product: Where Specifications name a single manufacturer and product, provide the named product that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.

a. Sole product may be indicated by the phrase "Subject to compliance with requirements, provide the following."

2. Sole Manufacturer/Source: Where Specifications name a single manufacturer or source, provide a product by the named manufacturer or source that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.

    a. Sole manufacturer/source may be indicated by the phrase "Subject to compliance with requirements, provide products by the following."

3. Limited List of Products: Where Specifications include a list of names of both manufacturers and products, provide one of the products listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered unless otherwise indicated.

    a. Limited list of products may be indicated by the phrase "Subject to compliance with requirements, provide one of the following."

4. Non-Limited List of Products: Where Specifications include a list of names of both available manufacturers and products, provide one of the products listed or an unnamed product that complies with requirements.

    a. Non-limited list of products is indicated by the phrase "Subject to compliance with requirements, available products that may be incorporated in the Work include, but are not limited to, the following."
    b. Provision of an unnamed product is not considered a substitution, if the product complies with requirements.

5. Limited List of Manufacturers: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered unless otherwise indicated.

    a. Limited list of manufacturers is indicated by the phrase "Subject to compliance with requirements, provide products by one of the following."

6. Non-Limited List of Manufacturers: Where Specifications include a list of available manufacturers, provide a product by one of the manufacturers listed or a product by an unnamed manufacturer that complies with requirements.

    a. Non-limited list of manufacturers is indicated by the phrase "Subject to compliance with requirements, available manufacturers whose products may be incorporated in the Work include, but are not limited to, the following."
    b. Provision of products of an unnamed manufacturer is not considered a substitution, if the product complies with requirements.

7. Basis-of-Design Product: Where Specifications name a product, or refer to a product indicated on Drawings, and include a list of manufacturers, provide the specified or indicated product or a comparable product by one of the other named manufacturers. If proposing a comparable product by another manufacturer, whether named or not, provide a custom product if manufacturer’s standard product does not include salient features of the Basis-of-Design product indicated. Drawings and Specifications may additionally indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product by one of the other named manufacturers.

C. Visual Matching Specification: Where Specifications require the phrase "match Architect's sample," provide a product that complies with requirements and matches Architect's sample. Architect's decision will be final on whether a proposed product matches.

D. Visual Selection Specification: Where Specifications include the phrase "as selected by Architect from manufacturer's full range" or a similar phrase, select a product that complies with requirements. Architect will select color, gloss, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.

E. Sustainable Product Selection: Where Specifications require product to meet sustainable product characteristics, select products complying with indicated requirements. Comply with requirements in Division 01 sustainability requirements Section and individual Specification Sections.

1. Select products for which sustainable design documentation submittals are available from manufacturer.

2.2 COMPARABLE PRODUCTS

A. Conditions for Consideration of Comparable Products: Architect will consider Contractor's request for comparable product when the following conditions are satisfied. If the following conditions are not satisfied, Architect may return requests without action, except to record noncompliance with the following requirements:

1. Evidence that proposed product does not require revisions to the Contract Documents, is consistent with the Contract Documents, will produce the indicated results, and is compatible with other portions of the Work.
2. Detailed comparison of significant qualities of proposed product with those of the named basis-of-design product. Significant product qualities include attributes, such as type, function, in-service performance and physical properties, weight, dimension, durability, visual characteristics, and other specific features and requirements.
3. Evidence that proposed product provides specified warranty.
4. List of similar installations for completed projects, with project names and addresses and names and addresses of architects and owners, if requested.
5. Samples, if requested.

B. Architect's Action on Comparable Products Submittal: If necessary, Architect will request additional information or documentation for evaluation, as specified in Section 01 33 00 "Submittal Procedures."

1. Form of Approval of Submittal: As specified in Section 01 33 00 "Submittal Procedures."
2. Use product specified if Architect does not issue a decision on use of a comparable product request within time allocated.

C. Submittal Requirements, Two-Step Process: Approval by Architect of Contractor's request for use of comparable product is not intended to satisfy other submittal requirements. Comply with specified submittal requirements.

PART 3 - EXECUTION (Not Used)

END OF SECTION

This page is intentionally left blank.

SECTION 01 73 00 - EXECUTION

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes general administrative and procedural requirements governing execution of the Work, including, but not limited to, the following:

1. Construction layout.
2. Field engineering and surveying.
3. Investigation of historic materials and assemblies in existing locations, dismantling and relocation.
4. Installation of the Work.
5. Cutting and patching.
6. Coordination of Owner's portion of the Work.
7. Coordination of Owner-installed products.
8. Coordination, restoration and re-installation of historic materials and assemblies.
9. Progress cleaning.
10. Starting and adjusting.
11. Protection of installed construction.
12. Correction of the Work.

B. Related Requirements:

1. Section 01 33 00 "Submittal Procedures" for submitting surveys.
2. Section 01 77 00 "Closeout Procedures" for submitting final property survey with Project Record Documents, recording of Owner-accepted deviations from indicated lines and levels, replacing defective work, and final cleaning.

1.2 DEFINITIONS

A. Cutting: Removal of in-place construction necessary to permit installation or performance of subsequent work.

B. Patching: Fitting and repair work required to restore construction to original conditions after installation of subsequent work.

1.3 PREINSTALLATION MEETINGS

A. Cutting and Patching Conference: Conduct conference at Project site.

1. Prior to commencing work requiring cutting and patching, review extent of cutting and patching anticipated and examine procedures for ensuring satisfactory result from cutting and patching work. Inform Architect of scheduled meeting. Require representatives of each entity directly concerned with cutting and patching to attend, including the following:

a. Contractor's superintendent.

b. Trade supervisor responsible for cutting operations.
c. Trade supervisor(s) responsible for patching of each type of substrate.
d. Mechanical, electrical, and utilities subcontractors' supervisors, to the extent each trade is affected by cutting and patching operations.

2. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.

B. Layout Conference: Conduct conference at Project site.

1. Prior to establishing layout of new perimeter and structural column grid(s), review building location requirements. Review benchmark, control point, and layout and dimension requirements. Inform Architect of scheduled meeting. Require representatives of each entity directly concerned with Project layout to attend, including the following:

a. Contractor's superintendent.
b. Professional surveyor responsible for performing Project surveying and layout.
c. Professional surveyor responsible for performing site survey serving as basis for Project design.

2. Review meanings and intent of dimensions, notes, terms, graphic symbols, and other layout information indicated on the Drawings.
3. Review requirements for including layouts on Shop Drawings and other submittals.
4. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.

C. Other preinstallation meetings as indicated and required, including those for historic marble columns work and historic architectural woodwork, with qualified specialists responsible for supervising performance of historic work present along with others indicated, and addressing subjects indicated, such as schedule for historic work within overall project schedule, investigations of historic materials in their existing locations and disassembly, relocation, restoration, and re-installation, also products and methods, submittals, approvals, preparations for the work and coordination, with meetings held early enough to accommodate anything changed or additional resulting from meetings without impacting overall project schedule.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For land surveyor.

B. Certified Surveys: Submit two copies signed by land surveyor.

C. Certificates: Submit certificate signed by land surveyor, certifying that location and elevation of improvements comply with requirements.

D. Historic Work: As indicated for historic marble columns and historic architectural woodwork, including required qualification data, written plans, quality-control programs and other quality assurance requirements, including for mockups and for action submittal requirements, and including for shop drawings, products and samples. Coordinate acceptable performance requirements with Owner and include in required written plans for Disassembly Methodology:

1. Extent: Describe reason for and extent of each occurrence of cutting and patching.

2. Changes to In-Place Construction: Describe anticipated results. Include changes to existing elements and operating components as well as changes in facility appearance and other significant visual elements.
3. Products: Indicate items proposed to be patched and products proposed to be used for patching, and qualified specialists who will perform patching work.
4. Schedule: Indicate when cutting and patching will be performed within schedules for historic work performance and ensure, with General Contractor, that historic work performance can be successfully accomplished within overall project schedule.
5. Utility Systems: Indicate services and systems that cutting and patching procedures will disturb or affect, and those that will be temporarily out of service. Indicate lengths of time any services and systems will be disrupted.

    a. If necessary per Owner, include description of temporary services and systems proposed during interruption of permanent services and systems.

E. Cutting and Patching Plan: Submit plan describing procedures at least 10 days prior to the time cutting and patching will be performed. Include the following information:

1. Extent: Describe reason for and extent of each occurrence of cutting and patching.
2. Changes to In-Place Construction: Describe anticipated results. Include changes to structural elements and operating components as well as changes in building appearance and other significant visual elements.
3. Products: List products to be used for patching and firms or entities that will perform patching work.
4. Dates: Indicate when cutting and patching will be performed.
5. Utilities and Mechanical and Electrical Systems: List services and systems that cutting and patching procedures will disturb or affect. List services and systems that will be relocated and those that will be temporarily out of service. Indicate length of time permanent services and systems will be disrupted.

    a. Include description of provisions for temporary services and systems during interruption of permanent services and systems.

F. Landfill Receipts: Submit copy of receipts issued by a landfill facility, licensed to accept hazardous materials, for hazardous waste disposal.

1.5 CLOSEOUT SUBMITTALS

A. Final Property Survey: Submit 10 copies showing the Work performed and record survey data.

1.6 QUALITY ASSURANCE

A. Land Surveyor Qualifications: A professional land surveyor who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing land-surveying services of the kind indicated.

B. Cutting and Patching: Comply with requirements for and limitations on cutting and patching of construction elements.

1. Structural Elements: When cutting and patching structural elements, or when encountering the need for cutting and patching of elements whose structural function is

not known, notify Architect of locations and details of cutting and await directions from Architect before proceeding. Shore, brace, and support structural elements during cutting and patching. Do not cut and patch structural elements in a manner that could change their load-carrying capacity or increase deflection.

2. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety.
3. Other Construction Elements: Do not cut and patch other construction elements or components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety.
4. Visual Elements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch exposed construction in a manner that would, in Architect's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.

C. Manufacturer's Installation Instructions: Obtain and maintain on-site manufacturer's written recommendations and instructions for installation of specified products and equipment.

D. Quality Assurance as indicated for historic work, including qualification certifications, written plans for methodologies and other indicated, schedule, protections, and coordination.

E. Cutting and Patching at existing Historic Courtroom: Comply with requirements for and limitations on cutting and patching of construction elements.

1. Structural Elements: When cutting and patching structural elements, or when encountering the need for cutting and patching of elements whose structural function is not known, notify Architect of locations and details of cutting and await directions from Architect before proceeding. Shore, brace, and support structural elements during cutting and patching. Do not cut and patch structural elements in a manner that could change their load-carrying capacity or increase deflection.
2. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety.
3. In required written plans for historic work include descriptions of procedures for cutting, and as appropriate, patching at existing site from where historic materials are to be removed. Coordinate cutting operations and patching required at this site with Owner, document requirements indicated, and perform in accordance with them.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Comply with requirements specified in other Sections.

1. For projects requiring compliance with sustainable design and construction practices and procedures, use products for patching that comply with sustainable design requirements.

B. In-Place Materials: Use materials for patching identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.

1. If identical materials are unavailable or cannot be used, use materials that, when installed, will provide a match acceptable to Architect for the visual and functional performance of in-place materials. Use materials that are not considered hazardous.

C. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

1. Use cleaning products that comply with Green Seal's GS-37, or if GS-37 is not applicable, use products that comply with the California Code of Regulations maximum allowable VOC levels.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Existing Conditions: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the existence and location of underground utilities, and other construction affecting the Work.

1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, gas service piping, and water-service piping; underground electrical services; and other utilities.
2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.

B. Examination and Acceptance of Conditions: Before proceeding with each component of the Work, examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.

1. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
2. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
3. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.

C. Written Report: Where a written report listing conditions detrimental to performance of the Work is required by other Sections, include the following:

1. Description of the Work, including Specification Section number and paragraph, and Drawing sheet number and detail, where applicable.
2. List of detrimental conditions, including substrates.
3. List of unacceptable installation tolerances.
4. Recommended corrections.

D. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

E. Investigate and assess historic materials in existing locations as indicated, document historic materials per investigations as indicated, and coordinate access to existing locations and work to be performed there with Owner.

3.2 PREPARATION

A. Existing Utility Information: Furnish information to local utility that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.

B. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

C. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.

D. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents, submit a request for information to Architect in accordance with requirements in Section 01 31 00 "Project Management and Coordination."

E. Historic Work: Perform investigations of historic marble columns and historic architectural woodwork required, report on findings as indicated, document historic materials and assemblies and submit written plans, shop drawings and proposed product data as indicated, and provide other items including Quality Assurance items prior to commencing work. Ensure that workers are qualified for work to be performed and those to perform work at existing site are sufficiently familiar with site and with requirements for work performance there, and that workers to perform work at new facility are likewise qualified and familiar with site, with overall project, with General Contractor and other contractors and others with whom interface will or may be required, and with requirements for work performance at site.

3.3 CONSTRUCTION LAYOUT

A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks and existing conditions. If discrepancies are discovered, notify Architect promptly.

B. Engage a land surveyor experienced in laying out the Work, using the following accepted surveying practices:

1. Establish benchmarks and control points to set lines and levels at each story of construction and elsewhere as needed to locate each element of Project.
2. Establish limits on use of Project site.
3. Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.
4. Inform installers of lines and levels to which they must comply.
5. Check the location, level and plumb, of every major element as the Work progresses.
6. Notify Architect when deviations from required lines and levels exceed allowable tolerances.

7. Close site surveys with an error of closure equal to or less than the standard established by authorities having jurisdiction.

C. Site Improvements: Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and rim and invert elevations.

D. Building Lines and Levels: Locate and lay out control lines and levels for structures, building foundations, column grids, and floor levels, including those required for mechanical and electrical work. Transfer survey markings and elevations for use with control lines and levels. Level foundations and piers from two or more locations.

E. Record Log: Maintain a log of layout control work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by Architect.

3.4 FIELD ENGINEERING

A. Identification: Owner will identify existing benchmarks, control points, and property corners.

B. Reference Points: Locate existing permanent benchmarks, control points, and similar reference points before beginning the Work. Preserve and protect permanent benchmarks and control points during construction operations.

1. Do not change or relocate existing benchmarks or control points without prior written approval of Architect. Report lost or destroyed permanent benchmarks or control points promptly. Report the need to relocate permanent benchmarks or control points to Architect before proceeding.
2. Replace lost or destroyed permanent benchmarks and control points promptly. Base replacements on the original survey control points.

C. Benchmarks: Establish and maintain a minimum of two permanent benchmarks on Project site, referenced to data established by survey control points. Comply with authorities having jurisdiction for type and size of benchmark.

1. Record benchmark locations, with horizontal and vertical data, on Project Record Documents.
2. Where the actual location or elevation of layout points cannot be marked, provide temporary reference points sufficient to locate the Work.
3. Remove temporary reference points when no longer needed. Restore marked construction to its original condition.

D. Certified Survey: On completion of foundation walls, major site improvements, and other work requiring field-engineering services, prepare a certified survey showing dimensions, locations, angles, and elevations of construction and sitework.

E. Final Property Survey: Engage a land surveyor to prepare a final property survey showing significant features (real property) for Project. Include on the survey a certification, signed by land surveyor, that principal metes, bounds, lines, and levels of Project are accurately positioned as shown on the survey.

1. Show boundary lines, monuments, streets, site improvements and utilities, existing improvements and significant vegetation, adjoining properties, acreage, grade contours, and the distance and bearing from a site corner to a legal point.

3.5 INSTALLATION

A. Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.

1. Make vertical work plumb, and make horizontal work level.
2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
3. Conceal pipes, ducts, and wiring in finished areas unless otherwise indicated.
4. Maintain minimum headroom clearance of 96 inches in occupied spaces and 90 inches in unoccupied spaces, unless otherwise indicated on Drawings.

B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.

C. Install products at the time and under conditions that will ensure satisfactory results as judged by Architect. Maintain conditions required for product performance until Substantial Completion.

D. Conduct construction operations, so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy of type expected for Project.

E. Ensure historic materials have been satisfactorily documented, transported, repaired, and prepared for installation, that work necessary prior is complete, needed supporting work and operations are provided, coordination and protection are properly addressed, and installation can be and is performed compliant with requirements and intent.

F. Sequence the Work and allow adequate clearances to accommodate movement of construction items on-site and placement in permanent locations.

G. Tools and Equipment: Select tools or equipment that minimize production of excessive noise levels.

H. Templates: Obtain and distribute to the parties involved templates for Work specified to be factory prepared and field installed. Check Shop Drawings of other portions of the Work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.

I. Attachment: Provide blocking and attachment plates and anchors and fasteners of adequate size and number to securely anchor each component in place, accurately located and aligned with other portions of the Work. Where size and type of attachments are not indicated, verify size and type required for load conditions with manufacturer.

1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect.
2. Allow for building movement, including thermal expansion and contraction.
3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with

integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

J. Joints: Make joints of uniform width. Where joint locations in exposed Work are not indicated, arrange joints for the best visual effect, as judged by Architect. Fit exposed connections together to form hairline joints.

3.6 CUTTING AND PATCHING

A. General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.

1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.

B. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during installation or cutting and patching operations, by methods and with materials so as not to void existing warranties.

C. Temporary Support: Provide temporary support of Work to be cut.

D. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.

E. Adjacent Occupied Areas: Where interference with use of adjoining areas or interruption of free passage to adjoining areas is unavoidable, coordinate cutting and patching in accordance with requirements in Section 02 41 19 "Selective Demolition."

F. Existing Utility Services and Mechanical/Electrical Systems: Where existing services/systems are required to be removed, relocated, or abandoned, bypass such services/systems before cutting to minimize interruption to occupied areas.

G. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction.

H. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other Work. Patch with durable seams that are as invisible as practicable, as judged by Architect. Provide materials and comply with installation requirements specified in other Sections, where applicable.

I. Cleaning: Clean areas and spaces where cutting and patching are performed. Remove paint, mortar, oils, putty, and similar materials from adjacent finished surfaces.

3.7 COORDINATION OF OWNER'S PORTION OF THE WORK

A. Site Access: Provide access to Project site for Owner's construction personnel and Owner's separate contractors.

1. Provide temporary facilities required for Owner-furnished, Contractor-installed and Owner-furnished, Owner-installed products.

B. Coordination: Coordinate construction and operations of the Work with work performed by Owner's construction personnel and Owner's separate contractors.

1. Construction Schedule: Inform Owner of Contractor's preferred construction schedule for Owner's portion of the Work. Adjust construction schedule based on a mutually agreeable timetable. Notify Owner if changes to schedule are required due to differences in actual construction progress.
2. Preinstallation Conferences: Include Owner's construction personnel and Owner's separate contractors at preinstallation conferences covering portions of the Work that are to receive Owner's work. Attend preinstallation conferences conducted by Owner's construction personnel if portions of the Work depend on Owner's construction.

3.8 PROGRESS CLEANING

A. Clean Project site and work areas daily, including common areas. Enforce requirements strictly. Dispose of materials lawfully.

1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
2. Do not hold waste materials more than seven days during normal weather or three days if the temperature is expected to rise above 80 deg F.
3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.

a. Use containers intended for holding waste materials of type to be stored.

B. Site: Maintain Project site free of waste materials and debris.

C. Work Areas: Clean areas where Work is in progress to the level of cleanliness necessary for proper execution of the Work.

1. Remove liquid spills promptly.
2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.

D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.

E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.

F. Exposed Surfaces: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.

G. Waste Disposal: Do not bury or burn waste materials on-site. Do not wash waste materials down sewers or into waterways. Comply with waste disposal requirements in Section 01 50 00 "Temporary Facilities and Controls."

H. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.

I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.

J. Limiting Exposures: Supervise construction operations to ensure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

3.9 STARTING AND ADJUSTING

A. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.

B. Adjust equipment for proper operation. Adjust operating components for proper operation without binding.

C. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Manufacturer's Field Service: Comply with qualification requirements in Section 01 40 00 "Quality Requirements."

3.10 PROTECTION OF INSTALLED CONSTRUCTION

A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.

B. Protection of Existing Items: Provide protection and ensure that existing items to remain undisturbed by construction are maintained in condition that existed at commencement of the Work.

C. Comply with manufacturer's written instructions for temperature and relative humidity.

3.11 CORRECTION OF THE WORK

A. Repair or remove and replace damaged, defective, or nonconforming Work. Restore damaged substrates and finishes.

1. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment.

B. Repair Work previously completed and subsequently damaged during construction period. Repair to like-new condition.

C. Restore permanent facilities used during construction to their specified condition.

D. Remove and replace damaged surfaces that are exposed to view if surfaces cannot be repaired without visible evidence of repair.

E. Repair components that do not operate properly. Remove and replace operating components that cannot be repaired.

F. Remove and replace chipped, scratched, and broken glass or reflective surfaces.

END OF SECTION

SECTION 01 74 19 - CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for the following:

1. Salvaging nonhazardous demolition and construction waste.
2. Recycling nonhazardous demolition and construction waste.
3. Disposing of nonhazardous demolition and construction waste.

B. Related Requirements:

1. Section 02 41 19 "Selective Demolition" for disposition of waste resulting from partial demolition of buildings, structures, and site improvements.

1.2 DEFINITIONS

A. Construction Waste: Building, structure, and site improvement materials and other solid waste resulting from construction, remodeling, renovation, or repair operations. Construction waste includes packaging.

B. Demolition Waste: Building, structure, and site improvement materials resulting from selective demolition operations.

C. Disposal: Removal off-site of demolition and construction waste and subsequent salvage, sale, recycling, or deposit in landfill, incinerator acceptable to authorities having jurisdiction.

D. Recycle: Recovery of demolition or construction waste for subsequent processing in preparation for reuse.

E. Salvage: Recovery of demolition or construction waste and subsequent sale or reuse in another facility.

F. Salvage and Reuse: Recovery of demolition or construction waste and subsequent incorporation into the Work.

1.3 MATERIALS OWNERSHIP

A. Unless otherwise indicated, demolition and construction waste becomes property of Contractor.

B. Historic items, relics, antiques, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, and other items of interest or value to Owner that may be uncovered during demolition remain the property of Owner.

1. Carefully salvage in a manner to prevent damage and promptly return to Owner.

1.4 ACTION SUBMITTALS

A. Waste Management Plan: Submit plan within 30 days of date established for commencement of the Work.

1.5 INFORMATIONAL SUBMITTALS

A. Waste Reduction Progress Reports: Concurrent with each Application for Payment, submit report. Use Form CWM-7 for construction waste and Form CWM-8 for demolition waste. Include the following information:

1. Material category.
2. Generation point of waste.
3. Total quantity of waste in tons.
4. Quantity of waste salvaged, both estimated and actual in tons.
5. Quantity of waste recycled, both estimated and actual in tons.
6. Total quantity of waste recovered (salvaged plus recycled) in tons.
7. Total quantity of waste recovered (salvaged plus recycled) as a percentage of total waste.

B. Waste Reduction Calculations: Before request for Substantial Completion, submit calculated end-of-Project rates for salvage, recycling, and disposal as a percentage of total waste generated by the Work.

C. Records of Donations: Indicate receipt and acceptance of salvageable waste donated to individuals and organizations. Indicate whether organization is tax exempt.

D. Records of Sales: Indicate receipt and acceptance of salvageable waste sold to individuals and organizations. Indicate whether organization is tax exempt.

E. Recycling and Processing Facility Records: Indicate receipt and acceptance of recyclable waste by recycling and processing facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.

F. Landfill and Incinerator Disposal Records: Indicate receipt and acceptance of waste by landfills and incinerator facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.

G. Qualification Data: For waste management coordinator and refrigerant recovery technician.

H. Refrigerant Recovery: Comply with requirements in Section 02 41 19 "Selective Demolition" for refrigerant recovery submittals.

1.6 QUALITY ASSURANCE

A. Waste Management Coordinator Qualifications: LEED-Accredited Professional, certified by USGBC, as waste management coordinator. Waste management coordinator may also serve as LEED coordinator.

B. Refrigerant Recovery Technician Qualifications: Comply with requirements in Section 02 41 19 "Selective Demolition."

C. Regulatory Requirements: Comply with transportation and disposal regulations of authorities having jurisdiction.

D. Waste Management Conference(s): Conduct conference(s) at Project site to comply with requirements in Section 01 31 00 "Project Management and Coordination." Review methods and procedures related to waste management including, but not limited to, the following:

1. Review and discuss waste management plan including responsibilities of each contractor and waste management coordinator.
2. Review requirements for documenting quantities of each type of waste and its disposition.
3. Review and finalize procedures for materials separation and verify availability of containers and bins needed to avoid delays.
4. Review procedures for periodic waste collection and transportation to recycling and disposal facilities.
5. Review waste management requirements for each trade.

1.7 WASTE MANAGEMENT PLAN

A. General: Develop a waste management plan according to requirements in this Section. Plan shall consist of waste identification, waste reduction work plan, and cost/revenue analysis. Indicate quantities by weight or volume, but use same units of measure throughout waste management plan.

B. Waste Identification: Indicate anticipated types and quantities of demolition, site-clearing and construction waste generated by the Work. Use Form CWM-1 for construction waste and Form CWM-2 for demolition waste. Include estimated quantities and assumptions for estimates.

C. Waste Reduction Work Plan: List each type of waste and whether it will be salvaged, recycled, or disposed of in landfill or incinerator. Use Form CWM-3 for construction waste and Form CWM-4 for demolition waste. Include points of waste generation, total quantity of each type of waste, quantity for each means of recovery, and handling and transportation procedures.

1. Salvaged Materials for Reuse: For materials that will be salvaged and reused in this Project, describe methods for preparing salvaged materials before incorporation into the Work in compliance with Section 02 41 19 "Selective Demolition."
2. Recycled Materials: Include list of local receivers and processors and type of recycled materials each will accept. Include names, addresses, and telephone numbers.
3. Disposed Materials: Indicate how and where materials will be disposed of. Include name, address, and telephone number of each landfill and incinerator facility.
4. Handling and Transportation Procedures: Include method that will be used for separating recyclable waste including sizes of containers, container labeling, and designated location where materials separation will be performed.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. General: Achieve end-of-Project rates for salvage/recycling of 60 percent by weight of total nonhazardous solid waste generated by the Work. Practice efficient waste management in the use of materials in the course of the Work. Use all reasonable means to divert construction and demolition waste from landfills and incinerators. Facilitate recycling and salvage of materials, including the following:

1. Demolition Waste:

a. Asphalt paving.
b. Concrete.
c. Concrete reinforcing steel.
d. Brick.
e. Concrete masonry units.
f. Wood studs.
g. Wood joists.
h. Plywood and oriented strand board.
i. Wood paneling.
j. Wood trim.
k. Structural and miscellaneous steel.
l. Rough hardware.
m. Roofing.
n. Insulation.
o. Doors and frames.
p. Door hardware.
q. Windows.
r. Glazing.
s. Metal studs.
t. Gypsum board.
u. Acoustical tile and panels.
v. Carpet.
w. Carpet pad.
x. Demountable partitions.
y. Equipment.
z. Cabinets.
aa. Plumbing fixtures.
bb. Piping.
cc. Supports and hangers.
dd. Valves.
ee. Sprinklers.
ff. Mechanical equipment.
gg. Refrigerants.
hh. Electrical conduit.
ii. Copper wiring.
jj. Lighting fixtures.
kk. Lamps.
ll. Ballasts.
mm. Electrical devices.
nn. Switchgear and panelboards.

oo. Transformers.

2. Construction Waste:

a. Masonry and CMU.
b. Lumber.
c. Wood sheet materials.
d. Wood trim.
e. Metals.
f. Roofing.
g. Insulation.
h. Carpet and pad.
i. Gypsum board.
j. Piping.
k. Electrical conduit.
l. Packaging: Regardless of salvage/recycle goal indicated in "General" Paragraph above, salvage or recycle 100 percent of the following uncontaminated packaging materials:

1) Paper.
2) Cardboard.
3) Boxes.
4) Plastic sheet and film.
5) Polystyrene packaging.
6) Wood crates.
7) Wood pallets.
8) Plastic pails.

m. Construction Office Waste: Regardless of salvage/recycle goal indicated in "General" Paragraph above, salvage or recycle 100 percent of the following construction office waste materials:

1) Paper.
2) Aluminum cans.
3) Glass containers.

PART 3 - EXECUTION

3.1 PLAN IMPLEMENTATION

A. General: Implement approved waste management plan. Provide handling, containers, storage, signage, transportation, and other items as required to implement waste management plan during the entire duration of the Contract.

1. Comply with operation, termination, and removal requirements in Section 01 50 00 "Temporary Facilities and Controls."

B. Waste Management Coordinator: Engage a waste management coordinator to be responsible for implementing, monitoring, and reporting status of waste management work plan. Coordinator shall be present at Project site full time for duration of the Project.

C. Training: Train workers, subcontractors, and suppliers on proper waste management procedures, as appropriate for the Work occurring at the Project site.

1. Distribute waste management plan to everyone concerned within three days of submittal return.
2. Distribute waste management plan to entities when they first begin work on-site. Review plan procedures and locations established for salvage, recycling, and disposal.

D. Site Access and Temporary Controls: Conduct waste management operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

1. Designate and label specific areas on Project site necessary for separating materials that are to be salvaged and recycled.
2. Comply with Section 01 50 00 "Temporary Facilities and Controls" for controlling dust and dirt, environmental protection, and noise control.

3.2 SALVAGING DEMOLITION WASTE

A. Comply with requirements in Section 024119 "Selective Demolition" for salvaging demolition waste.

3.3 RECYCLING DEMOLITION AND CONSTRUCTION WASTE, GENERAL

A. General: Recycle paper and beverage containers used by on-site workers.

B. Recycling Incentives: Revenues, savings, rebates, tax credits, and other incentives received for recycling waste materials shall accrue to Contractor.

C. Preparation of Waste: Prepare and maintain recyclable waste materials according to recycling or reuse facility requirements. Maintain materials free of dirt, adhesives, solvents, petroleum contamination, and other substances deleterious to the recycling process.

D. Procedures: Separate recyclable waste from other waste materials, trash, and debris. Separate recyclable waste by type at Project site to the maximum extent practical according to approved construction waste management plan.

1. Provide appropriately marked containers or bins for controlling recyclable waste until removed from Project site. Include list of acceptable and unacceptable materials at each container and bin.

    a. Inspect containers and bins for contamination and remove contaminated materials if found.

2. Stockpile processed materials on-site without intermixing with other materials. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
3. Stockpile materials away from construction area. Do not store within drip line of remaining trees.
4. Store components off the ground and protect from the weather.
5. Remove recyclable waste from Owner's property and transport to recycling receiver or processor as often as required to prevent overfilling bins.

3.4 RECYCLING DEMOLITION WASTE

A. Asphalt Paving: Break up and transport paving to asphalt-recycling facility.

B. Concrete: Remove reinforcement and other metals from concrete and sort with other metals.

C. Masonry: Remove metal reinforcement, anchors, and ties from masonry and sort with other metals.

1. Clean and stack undamaged, whole masonry units on wood pallets.

D. Wood Materials: Sort and stack members according to size, type, and length. Separate lumber, engineered wood products, panel products, and treated wood materials.

E. Metals: Separate metals by type.

1. Structural Steel: Stack members according to size, type of member, and length.
2. Remove and dispose of bolts, nuts, washers, and other rough hardware.

F. Gypsum Board: Stack large clean pieces on wood pallets or in container and store in a dry location. Remove edge trim and sort with other metals. Remove and dispose of fasteners.

G. Acoustical Ceiling Panels and Tile: Stack large clean pieces on wood pallets and store in a dry location.

H. Metal Suspension System: Separate metal members, including trim and other metals from acoustical panels and tile, and sort with other metals.

I. Carpet and Pad: Roll large pieces tightly after removing debris, trash, adhesive, and tack strips.

1. Store clean, dry carpet and pad in a closed container or trailer provided by carpet reclamation agency or carpet recycler.

J. Carpet Tile: Remove debris, trash, and adhesive.

1. Stack tile on pallet and store clean, dry carpet in a closed container or trailer provided by carpet reclamation agency or carpet recycler.

K. Piping: Reduce piping to straight lengths and store by material and size. Separate supports, hangers, valves, sprinklers, and other components by material and size.

L. Conduit: Reduce conduit to straight lengths and store by material and size.

M. Lamps: Separate lamps by type and store according to requirements in 40 CFR 273.

3.5 RECYCLING CONSTRUCTION WASTE

A. Packaging:

1. Cardboard and Boxes: Break down packaging into flat sheets. Bundle and store in a dry location.

2. Polystyrene Packaging: Separate and bag materials.
3. Pallets: As much as possible, require deliveries using pallets to remove pallets from Project site. For pallets that remain on-site, break down pallets into component wood pieces and comply with requirements for recycling wood.
4. Crates: Break down crates into component wood pieces and comply with requirements for recycling wood.

B. Wood Materials:

1. Clean Cut-Offs of Lumber: Grind or chip into small pieces.
2. Clean Sawdust: Bag sawdust that does not contain painted or treated wood.

C. Gypsum Board: Stack large clean pieces on wood pallets or in container and store in a dry location.

1. Clean Gypsum Board: Grind scraps of clean gypsum board using small mobile chipper or hammer mill. Screen out paper after grinding.

D. Paint: Seal containers and store by type.

3.6 DISPOSAL OF WASTE

A. General: Except for items or materials to be salvaged or recycled, remove waste materials from Project site and legally dispose of them in a landfill or incinerator acceptable to authorities having jurisdiction.

1. Except as otherwise specified, do not allow waste materials that are to be disposed of accumulate on-site.
2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.

B. Burning: Do not burn waste materials.

3.7 ATTACHMENTS

A. Form CWM-1 for construction waste identification.

B. Form CWM-2 for demolition waste identification.

C. Form CWM-3 for construction waste reduction work plan.

D. Form CWM-4 for demolition waste reduction work plan.

E. Form CWM-5 for cost/revenue analysis of construction waste reduction work plan.

F. Form CWM-6 for cost/revenue analysis of demolition waste reduction work plan.

G. Form CWM-7 for construction waste reduction progress report.

H. Form CWM-8 for demolition waste reduction progress report.

END OF SECTION

This page is intentionally left blank.

FORM CWM-1: CONSTRUCTION WASTE IDENTIFICATION

MATERIAL CATEGORY	GENERATION POINT	EST. QUANTITY OF MATERIALS RECEIVED* (A)	EST. WASTE - % (B)	TOTAL EST. QUANTITY OF WASTE* (C = A x B)	EST. VOLUME CY (CM)	EST. WEIGHT TONS (TONNES)	REMARKS AND ASSUMPTIONS
Packaging: Cardboard							
Packaging: Boxes							
Packaging: Plastic Sheet or Film							
Packaging: Polystyrene							
Packaging: Pallets or Skids							
Packaging: Crates							
Packaging: Paint Cans							
Packaging: Plastic Pails							
Site-Clearing Waste							
Masonry or CMU							
Lumber: Cut-Offs							
Lumber: Warped Pieces							
Plywood or OSB (scraps)							
Wood Forms							
Wood Waste Chutes							
Wood Trim (cut-offs)							
Metals							
Insulation							
Roofing							
Joint Sealant Tubes							
Gypsum Board (scraps)							
Carpet and Pad (scraps)							
Piping							
Electrical Conduit							
Other:							

* Insert units of measure.

FORM CWM-2: DEMOLITION WASTE IDENTIFICATION

MATERIAL DESCRIPTION	EST. QUANTITY	EST. VOLUME CY (CM)	EST. WEIGHT TONS (TONNES)	REMARKS AND ASSUMPTIONS
Asphaltic Concrete Paving				
Concrete				
Brick				
CMU				
Lumber				
Plywood and OSB				
Wood Paneling				
Wood Trim				
Miscellaneous Metals				
Structural Steel				
Rough Hardware				
Insulation				
Roofing				
Doors and Frames				
Door Hardware				
Windows				
Glazing				
Acoustical Tile				
Carpet				
Carpet Pad				
Demountable Partitions				
Equipment				
Cabinets				
Plumbing Fixtures				
Piping				
Piping Supports and Hangers				
Valves				
Sprinklers				
Mechanical Equipment				
Electrical Conduit				
Copper Wiring				
Light Fixtures				
Lamps				
Lighting Ballasts				
Electrical Devices				
Switchgear and Panelboards				
Transformers				
Other:				

FORM CWM-3: CONSTRUCTION WASTE REDUCTION WORK PLAN

MATERIAL CATEGORY	GENERATION POINT	TOTAL EST. QUANTITY OF WASTE TONS (TONNES)	DISPOSAL METHOD AND QUANTITY			HANDLING AND TRANSPORTION PROCEDURES
			EST. AMOUNT SALVAGED TONS (TONNES)	EST. AMOUNT RECYCLED TONS (TONNES)	EST. AMOUNT DISPOSED TO LANDFILL TONS (TONNES)	
Packaging: Cardboard						
Packaging: Boxes						
Packaging: Plastic Sheet or Film						
Packaging: Polystyrene						
Packaging: Pallets or Skids						
Packaging: Crates						
Packaging: Paint Cans						
Packaging: Plastic Pails						
Site-Clearing Waste						
Masonry or CMU						
Lumber: Cut-Offs						
Lumber: Warped Pieces						
Plywood or OSB (scraps)						
Wood Forms						
Wood Waste Chutes						
Wood Trim (cut-offs)						
Metals						
Insulation						
Roofing						
Joint Sealant Tubes						
Gypsum Board (scraps)						
Carpet and Pad (scraps)						
Piping						
Electrical Conduit						
Other:						

FORM CWM-4: DEMOLITION WASTE REDUCTION WORK PLAN

MATERIAL CATEGORY	GENERATION POINT	TOTAL EST. QUANTITY OF WASTE TONS (TONNES)	DISPOSAL METHOD AND QUANTITY			HANDLING AND TRANSPORTION PROCEDURES
			EST. AMOUNT SALVAGED TONS (TONNES)	EST. AMOUNT RECYCLED TONS (TONNES)	EST. AMOUNT DISPOSED TO LANDFILL TONS (TONNES)	
Asphaltic Concrete Paving						
Concrete						
Brick						
CMU						
Lumber						
Plywood and OSB						
Wood Paneling						
Wood Trim						
Miscellaneous Metals						
Structural Steel						
Rough Hardware						
Insulation						
Roofing						
Doors and Frames						
Door Hardware						
Windows						
Glazing						
Acoustical Tile						
Carpet						
Carpet Pad						
Demountable Partitions						
Equipment						
Cabinets						
Plumbing Fixtures						
Piping						
Supports and Hangers						
Valves						
Sprinklers						
Mechanical Equipment						
Electrical Conduit						
Copper Wiring						
Light Fixtures						
Lamps						
Lighting Ballasts						
Electrical Devices						
Switchgear and Panelboards						
Transformers						
Other:						

FORM CWM-5: COST/REVENUE ANALYSIS OF CONSTRUCTION WASTE REDUCTION WORK PLAN

MATERIALS	TOTAL QUANTITY OF MATERIALS (VOL. OR WEIGHT) (A)	EST. COST OF DISPOSAL (B)	TOTAL EST. COST OF DISPOSAL (C = A x B)	REVENUE FROM SALVAGED MATERIALS (D)	REVENUE FROM RECYCLED MATERIALS (E)	LANDFILL TIPPING FEES AVOIDED (F)	HANDLING AND TRANSPORTATION COSTS AVOIDED (G)	NET COST SAVINGS OF WORK PLAN (H = D+E+F+G)
Packaging: Cardboard								
Packaging: Boxes								
Packaging: Plastic Sheet or Film								
Packaging: Polystyrene								
Packaging: Pallets or Skids								
Packaging: Crates								
Packaging: Paint Cans								
Packaging: Plastic Pails								
Site-Clearing Waste								
Masonry or CMU								
Lumber: Cut-Offs								
Lumber: Warped Pieces								
Plywood or OSB (scraps)								
Wood Forms								
Wood Waste Chutes								
Wood Trim (cut-offs)								
Metals								
Insulation								
Roofing								
Joint Sealant Tubes								
Gypsum Board (scraps)								
Carpet and Pad (scraps)								
Piping								
Electrical Conduit								
Other:								

FORM CWM-6: COST/REVENUE ANALYSIS OF DEMOLITION WASTE REDUCTION WORK PLAN

MATERIALS	TOTAL QUANTITY OF MATERIALS (VOL. OR WEIGHT) (A)	EST. COST OF DISPOSAL (B)	TOTAL EST. COST OF DISPOSAL (C = A x B)	REVENUE FROM SALVAGED MATERIALS (D)	REVENUE FROM RECYCLED MATERIALS (E)	LANDFILL TIPPING FEES AVOIDED (F)	HANDLING AND TRANSPORTATION COSTS AVOIDED (G)	NET COST SAVINGS OF WORK PLAN (H = D+E+F+G)
Asphaltic Concrete Paving								
Concrete								
Brick								
CMU								
Lumber								
Plywood and OSB								
Wood Paneling								
Wood Trim								
Miscellaneous Metals								
Structural Steel								
Rough Hardware								
Insulation								
Roofing								
Doors and Frames								
Door Hardware								
Windows								
Glazing								
Acoustical Tile								
Carpet								
Carpet Pad								
Demountable Partitions								
Equipment								
Cabinets								
Plumbing Fixtures								
Piping								
Supports and Hangers								
Valves								
Sprinklers								
Mech. Equipment								
Electrical Conduit								
Copper Wiring								
Light Fixtures								
Lamps								
Lighting Ballasts								
Electrical Devices								
Switchgear and Panelboards								
Transformers								
Other:								

FORM CWM-7: CONSTRUCTION WASTE REDUCTION PROGRESS REPORT

MATERIAL CATEGORY	GENERATION POINT	TOTAL QUANTITY OF WASTE TONS (TONNES) (A)	QUANTITY OF WASTE SALVAGED		QUANTITY OF WASTE RECYCLED		TOTAL QUANTITY OF WASTE RECOVERED TONS (TONNES) (D = B + C)	TOTAL QUANTITY OF WASTE RECOVERED % (D / A x 100)
			ESTIMATED TONS (TONNES)	ACTUAL TONS (TONNES) (B)	ESTIMATED TONS (TONNES)	ACTUAL TONS (TONNES) (C)		
Packaging: Cardboard								
Packaging: Boxes								
Packaging: Plastic Sheet or Film								
Packaging: Polystyrene								
Packaging: Pallets or Skids								
Packaging: Crates								
Packaging: Paint Cans								
Packaging: Plastic Pails								
Site-Clearing Waste								
Masonry or CMU								
Lumber: Cut-Offs								
Lumber: Warped Pieces								
Plywood or OSB (scraps)								
Wood Forms								
Wood Waste Chutes								
Wood Trim (cut-offs)								
Metals								
Insulation								
Roofing								
Joint Sealant Tubes								
Gypsum Board (scraps)								
Carpet and Pad (scraps)								
Piping								
Electrical Conduit								
Other:								

FORM CWM-8: DEMOLITION WASTE REDUCTION PROGRESS REPORT

MATERIAL CATEGORY	GENERATION POINT	TOTAL QUANTITY OF WASTE TONS (TONNES) (A)	QUANTITY OF WASTE SALVAGED		QUANTITY OF WASTE RECYCLED		TOTAL QUANTITY OF WASTE RECOVERED TONS (TONNES) (D = B + C)	TOTAL QUANTITY OF WASTE RECOVERED % (D / A x 100)
			ESTIMATED TONS (TONNES)	ACTUAL TONS (TONNES) (B)	ESTIMATED TONS (TONNES)	ACTUAL TONS (TONNES) (C)		
Asphaltic Concrete Paving								
Concrete								
Brick								
CMU								
Lumber								
Plywood and OSB								
Wood Paneling								
Wood Trim								
Miscellaneous Metals								
Structural Steel								
Rough Hardware								
Insulation								
Roofing								
Doors and Frames								
Door Hardware								
Windows								
Glazing								
Acoustical Tile								
Carpet								
Carpet Pad								
Demountable Partitions								
Equipment								
Cabinets								
Plumbing Fixtures								
Piping								
Supports and Hangers								
Valves								
Sprinklers								
Mechanical Equipment								
Electrical Conduit								
Copper Wiring								
Light Fixtures								
Lamps								
Lighting Ballasts								
Electrical Devices								
Switchgear and Panelboards								
Transformers								
Other:								

SECTION 01 77 00 - CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for Contract closeout, including, but not limited to, the following:

1. Substantial Completion procedures.
2. Final completion procedures.
3. Warranties.
4. Final cleaning.

B. Related Requirements:

1. Section 01 29 00 "Payment Procedures" for requirements for Applications for Payment for Substantial Completion and Final Completion.
2. Section 01 78 23 "Operation and Maintenance Data" for additional operation and maintenance manual requirements.
3. Section 01 78 39 "Project Record Documents" for submitting Record Drawings, Record Specifications, and Record Product Data.
4. Section 01 79 00 "Demonstration and Training" for requirements to train the Owner's maintenance personnel to adjust, operate, and maintain products, equipment, and systems.

1.2 DEFINITIONS

A. List of Incomplete Items: Contractor-prepared list of items to be completed or corrected, prepared for the Architect's use prior to Architect's inspection, to determine if the Work is substantially complete.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of cleaning agent.

B. Contractor's List of Incomplete Items: Initial submittal at Substantial Completion.

C. Certified List of Incomplete Items: Final submittal at Final Completion.

1.4 CLOSEOUT SUBMITTALS

A. Certificates of Release: From authorities having jurisdiction.

B. Certificate of Insurance: For continuing coverage.

C. Field Report: For pest-control inspection.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Schedule of Maintenance Material Items: For maintenance material submittal items required by other Sections.

1.6 SUBSTANTIAL COMPLETION PROCEDURES

A. Contractor's List of Incomplete Items: Prepare and submit a list of items to be completed and corrected (Contractor's "punch list"), indicating the value of each item on the list and reasons why the Work is incomplete.

B. Submittals Prior to Substantial Completion: Complete the following a minimum of 14 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.

1. Certificates of Release: Obtain and submit releases from authorities having jurisdiction, permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
2. Submit closeout submittals specified in other Division 01 Sections, including Project Record Documents, operation and maintenance manuals, damage or settlement surveys, property surveys, and similar final record information.
3. Submit closeout submittals specified in individual Sections, including specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
4. Submit maintenance material submittals specified in individual Sections, including tools, spare parts, extra materials, and similar items, and deliver to location designated by Owner. Label with manufacturer's name and model number.

    a. Schedule of Maintenance Material Items: Prepare and submit schedule of maintenance material submittal items, including name and quantity of each item and name and number of related Specification Section. Obtain Owner's signature for receipt of submittals.

5. Submit testing, adjusting, and balancing records.
6. Submit sustainable design submittals not previously submitted.
7. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.

C. Procedures Prior to Substantial Completion: Complete the following a minimum of 14 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.

1. Advise Owner of pending insurance changeover requirements.
2. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
3. Complete startup and testing of systems and equipment.
4. Perform preventive maintenance on equipment used prior to Substantial Completion.

5. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems. Submit demonstration and training video recordings specified in Section 01 79 00 "Demonstration and Training."
6. Advise Owner of changeover in utility services.
7. Participate with Owner in conducting inspection and walkthrough with local emergency responders.
8. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
9. Complete final cleaning requirements.
10. Touch up paint and otherwise repair and restore marred exposed finishes to eliminate visual defects.

D. Inspection: Submit a written request for inspection to determine Substantial Completion a minimum of 14 days prior to date the Work will be completed and ready for inspection and tests. On receipt of request, Architect and Owner will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Architect, that must be completed or corrected before certificate will be issued.

1. Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
2. Results of completed inspection will form the basis of requirements for Final Completion.

1.7 FINAL COMPLETION PROCEDURES

A. Submittals Prior to Final Completion: Before requesting final inspection for determining Final Completion, complete the following:

1. Submit a final Application for Payment in accordance with Section 01 29 00 "Payment Procedures."
2. Certified List of Incomplete Items: Submit certified copy of Architect's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Architect. Certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
3. Certificate of Insurance: Submit evidence of final, continuing insurance coverage complying with insurance requirements.
4. Submit pest-control final inspection report.
5. Submit Final Completion photographic documentation.

B. Inspection: Submit a written request for final inspection to determine acceptance a minimum of 14 days prior to date the Work will be completed and ready for final inspection and tests. On receipt of request, Architect and Owner will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.

1. Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

1.8 LIST OF INCOMPLETE ITEMS

A. Organization of List: Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction.

1. Organize list of spaces in sequential order, starting with exterior areas first and proceeding with interior areas from lowest floor to highest floor, listed by room or space number.
2. Organize items applying to each space by major element, including categories for ceilings, individual walls, floors, equipment, and building systems.
3. Include the following information at the top of each page:

a. Project name.
b. Date.
c. Name of Architect.
d. Name of Contractor.
e. Page number.

4. Submit list of incomplete items in the one of the following formats, as approved by Architect:

a. MS Excel Electronic File: Architect will return annotated file.
b. PDF Electronic File: Architect will return annotated file.
c. Web-Based Project Software Upload: Utilize software feature for creating and updating list of incomplete items (punch list).

1.9 SUBMITTAL OF PROJECT WARRANTIES

A. Time of Submittal: Submit written warranties on request of Architect for designated portions of the Work where warranties are indicated to commence on dates other than date of Substantial Completion, or when delay in submittal of warranties might limit Owner's rights under warranty.

B. Partial Occupancy: Submit properly executed warranties within 14 days of completion of designated portions of the Work that are completed and occupied or used by Owner during construction period by separate agreement with Contractor.

C. Organize warranty documents into an orderly sequence based on the table of contents of Project Manual.

D. Warranty Electronic File: Provide warranties and bonds in PDF format. Assemble complete warranty and bond submittal package into a single electronic PDF file with bookmarks enabling navigation to each item. Provide bookmarked table of contents at beginning of document.

1. Submit on digital media acceptable to Architect.

E. Warranties in Paper Form:

1. Bind warranties and bonds in heavy-duty, three-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-by-11-inch paper.

2. Provide heavy paper dividers with plastic-covered tabs for each separate warranty. Mark tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product and the name, address, and telephone number of Installer.
3. Identify each binder on the front and spine with the typed or printed title "WARRANTIES," Project name, and name of Contractor.

F. Provide additional copies of each warranty to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

1. Use cleaning products that comply with Green Seal's GS-37, or if GS-37 is not applicable, use products that comply with the California Code of Regulations maximum allowable VOC levels.

PART 3 - EXECUTION

3.1 FINAL CLEANING

A. General: Perform final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.

B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.

1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a designated portion of Project:

a. Clean Project site of rubbish, waste material, litter, and other foreign substances.
b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
c. Rake grounds that are not planted, mulched, or paved to a smooth, even-textured surface.
d. Remove tools, construction equipment, machinery, and surplus material from Project site.
e. Remove snow and ice to provide safe access to building.
f. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
g. Remove debris and surface dust from limited-access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.

h. Clean flooring, removing debris, dirt, and staining; clean according to manufacturer's recommendations.
i. Vacuum and mop concrete.
j. Vacuum carpet and similar soft surfaces, removing debris and excess nap; clean according to manufacturer's recommendations if visible soil or stains remain.
k. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Polish mirrors and glass, taking care not to scratch surfaces.
l. Remove labels that are not permanent.
m. Wipe surfaces of mechanical and electrical equipment, elevator equipment, and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
n. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
o. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
p. Clean ducts, blowers, and coils.
q. Clean luminaires, lamps, globes, and reflectors to function with full efficiency.
r. Clean strainers.
s. Leave Project clean and ready for occupancy.

C. Pest Control: Comply with pest control requirements in Section 01 50 00 "Temporary Facilities and Controls." Prepare written report.

D. Construction Waste Disposal: Comply with waste-disposal requirements in Section 01 50 00 "Temporary Facilities and Controls."

3.2 REPAIR OF THE WORK

A. Complete repair and restoration operations required by Section 01 73 00 "Execution" before requesting inspection for determination of Substantial Completion.

END OF SECTION

SECTION 01 78 23 - OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:

1. Operation and maintenance documentation directory manuals.
2. Emergency manuals.
3. Systems and equipment operation manuals.
4. Systems and equipment maintenance manuals.
5. Product maintenance manuals.

B. Related Requirements:

1. Section 01 33 00 "Submittal Procedures" for submitting copies of submittals for operation and maintenance manuals.
2. See Divisions 02 through 33 Sections for specific operation and maintenance manual requirements for the Work in those Sections.

1.2 DEFINITIONS

A. System: An organized collection of parts, equipment, or subsystems united by regular interaction.

B. Subsystem: A portion of a system with characteristics similar to a system.

1.3 CLOSEOUT SUBMITTALS

A. Submit operation and maintenance manuals indicated. Provide content for each manual as specified in individual Specification Sections, and as reviewed and approved at the time of Section submittals. Submit reviewed manual content formatted and organized as required by this Section.

1. Architect and Commissioning Authority will comment on whether content of operation and maintenance submittals is acceptable.
2. Where applicable, clarify and update reviewed manual content to correspond to revisions and field conditions.

B. Format: Submit operation and maintenance manuals in the following format:

1. Submit electronic files on digital media acceptable to Architect and by uploading to web-based project software site. Enable reviewer comments on draft submittals.
2. Submit three paper copies. Architect will return one copy and transmit two copies of final manual to Owner.

C. Initial Manual Submittal: Submit draft copy of each manual at 50 percent project time completion. Architect and Commissioning Authority will comment on whether general scope and content of manual are acceptable.

D. Final Manual Submittal: Submit each manual in final form prior to requesting inspection for Substantial Completion and at least 14 days before commencing demonstration and training. Architect and Commissioning Authority will return copy with comments.

1. Correct or revise each manual to comply with Architect's and Commissioning Authority's comments. Submit copies of each corrected manual within 14 days of receipt of Architect's comments and prior to commencing demonstration and training.

E. Comply with Section 01 77 00 "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

1.4 FORMAT OF OPERATION AND MAINTENANCE MANUALS

A. Manuals, Electronic Files: Submit manuals in the form of a multiple file composite electronic PDF file for each manual type required.

1. Electronic Files: Use electronic files prepared by manufacturer where available. Where scanning of paper documents is required, configure scanned file for minimum readable file size.
2. File Names and Bookmarks: Bookmark individual documents based on file names. Name document files to correspond to system, subsystem, and equipment names used in manual directory and table of contents. Group documents for each system and subsystem into individual composite bookmarked files, then create composite manual, so that resulting bookmarks reflect the system, subsystem, and equipment names in a readily navigated file tree. Configure electronic manual to display bookmark panel on opening file.

B. Manuals, Paper Copy: Submit manuals in the form of hard-copy, bound and labeled volumes.

1. Binders: Heavy-duty, three-ring, vinyl-covered, post-type loose leaf binders, in thickness necessary to accommodate contents, sized to hold 8-1/2-by-11-inch paper; with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.

a. If two or more binders are necessary to accommodate data of a system, organize data in each binder into groupings by subsystem and related components. Cross-reference other binders if necessary to provide essential information for proper operation or maintenance of equipment or system.
b. Identify each binder on front and spine, with printed title "OPERATION AND MAINTENANCE MANUAL," Project title or name, subject matter of contents, and indicate Specification Section number on bottom of spine. Indicate volume number for multiple-volume sets.

2. Dividers: Heavy-paper dividers with plastic-covered tabs for each section of the manual. Mark each tab to indicate contents. Include typed list of products and major components of equipment included in the section on each divider, cross-referenced to Specification Section number and title of Project Manual.

3. Protective Plastic Sleeves: Transparent plastic sleeves designed to enclose diagnostic software storage media for computerized electronic equipment. Enclose title pages and directories in clear plastic sleeves.
4. Supplementary Text: Prepared on 8-1/2-by-11-inch white bond paper.
5. Drawings: Attach reinforced, punched binder tabs on drawings and bind with text.

    a. If oversize drawings are necessary, fold drawings to same size as text pages and use as foldouts.
    b. If drawings are too large to be used as foldouts, fold and place drawings in labeled envelopes and bind envelopes in rear of manual. At appropriate locations in manual, insert typewritten pages indicating drawing titles, descriptions of contents, and drawing locations.

1.5 REQUIREMENTS FOR EMERGENCY, OPERATION, AND MAINTENANCE MANUALS

A. Organization of Manuals: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain the following materials, in the order listed:

1. Title page.
2. Table of contents.
3. Manual contents.

B. Title Page: Include the following information:

1. Subject matter included in manual.
2. Name and address of Project.
3. Name and address of Owner.
4. Date of submittal.
5. Name and contact information for Contractor.
6. Name and contact information for Architect.
7. Name and contact information for Commissioning Authority.
8. Names and contact information for major consultants to the Architect that designed the systems contained in the manuals.
9. Cross-reference to related systems in other operation and maintenance manuals.

C. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.

1. If operation or maintenance documentation requires more than one volume to accommodate data, include comprehensive table of contents for all volumes in each volume of the set.

D. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.

E. Identification: In the documentation directory and in each operation and maintenance manual, identify each system, subsystem, and piece of equipment with same designation used in the Contract Documents. If no designation exists, assign a designation according to

ASHRAE Guideline 4, "Preparation of Operating and Maintenance Documentation for Building Systems."

1.6 OPERATION AND MAINTENANCE DOCUMENTATION DIRECTORY MANUAL

A. Operation and Maintenance Documentation Directory: Prepare a separate manual that provides an organized reference to emergency, operation, and maintenance manuals. List items and their location to facilitate ready access to desired information. Include the following:

1. List of Systems and Subsystems: List systems alphabetically. Include references to operation and maintenance manuals that contain information about each system.
2. List of Equipment: List equipment for each system, organized alphabetically by system. For pieces of equipment not part of system, list alphabetically in separate list.
3. Tables of Contents: Include a table of contents for each emergency, operation, and maintenance manual.

1.7 EMERGENCY MANUALS

A. Emergency Manual: Assemble a complete set of emergency information indicating procedures for use by emergency personnel and by Owner's operating personnel for types of emergencies indicated.

B. Content: Organize manual into a separate section for each of the following:

1. Type of emergency.
2. Emergency instructions.
3. Emergency procedures.

C. Type of Emergency: Where applicable for each type of emergency indicated below, include instructions and procedures for each system, subsystem, piece of equipment, and component:

1. Fire.
2. Flood.
3. Gas leak.
4. Water leak.
5. Power failure.
6. Water outage.
7. System, subsystem, or equipment failure.
8. Chemical release or spill.

D. Emergency Instructions: Describe and explain warnings, trouble indications, error messages, and similar codes and signals. Include responsibilities of Owner's operating personnel for notification of Installer, supplier, and manufacturer to maintain warranties.

E. Emergency Procedures: Include the following, as applicable:

1. Instructions on stopping.
2. Shutdown instructions for each type of emergency.
3. Operating instructions for conditions outside normal operating limits.
4. Required sequences for electric or electronic systems.
5. Special operating instructions and procedures.

1.8 SYSTEMS AND EQUIPMENT OPERATION MANUALS

A. Systems and Equipment Operation Manual: Assemble a complete set of data indicating operation of each system, subsystem, and piece of equipment not part of a system. Include information required for daily operation and management, operating standards, and routine and special operating procedures.

1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.

B. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and the following information:

1. System, subsystem, and equipment descriptions. Use designations for systems and equipment indicated on Contract Documents.
2. Performance and design criteria if Contractor has delegated design responsibility.
3. Operating standards.
4. Operating procedures.
5. Operating logs.
6. Wiring diagrams.
7. Control diagrams.
8. Piped system diagrams.
9. Precautions against improper use.
10. License requirements including inspection and renewal dates.

C. Descriptions: Include the following:

1. Product name and model number. Use designations for products indicated on Contract Documents.
2. Manufacturer's name.
3. Equipment identification with serial number of each component.
4. Equipment function.
5. Operating characteristics.
6. Limiting conditions.
7. Performance curves.
8. Engineering data and tests.
9. Complete nomenclature and number of replacement parts.

D. Operating Procedures: Include the following, as applicable:

1. Startup procedures.
2. Equipment or system break-in procedures.
3. Routine and normal operating instructions.
4. Regulation and control procedures.
5. Instructions on stopping.
6. Normal shutdown instructions.
7. Seasonal and weekend operating instructions.
8. Required sequences for electric or electronic systems.
9. Special operating instructions and procedures.

E. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.

F. Piped Systems: Diagram piping as installed, and identify color coding where required for identification.

1.9 SYSTEMS AND EQUIPMENT MAINTENANCE MANUALS

A. Systems and Equipment Maintenance Manuals: Assemble a complete set of data indicating maintenance of each system, subsystem, and piece of equipment not part of a system. Include manufacturers' maintenance documentation, preventive maintenance procedures and frequency, repair procedures, wiring and systems diagrams, lists of spare parts, and warranty information.

1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.

B. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranties and bonds as described below.

C. Source Information: List each system, subsystem, and piece of equipment included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.

D. Manufacturers' Maintenance Documentation: Include the following information for each component part or piece of equipment:

1. Standard maintenance instructions and bulletins; include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.

    a. Prepare supplementary text if manufacturers' standard printed data are not available and where the information is necessary for proper operation and maintenance of equipment or systems.

2. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.
3. Identification and nomenclature of parts and components.
4. List of items recommended to be stocked as spare parts.

E. Maintenance Procedures: Include the following information and items that detail essential maintenance procedures:

1. Test and inspection instructions.

2. Troubleshooting guide.
3. Precautions against improper maintenance.
4. Disassembly; component removal, repair, and replacement; and reassembly instructions.
5. Aligning, adjusting, and checking instructions.
6. Demonstration and training video recording, if available.

F. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.

1. Scheduled Maintenance and Service: Tabulate actions for daily, weekly, monthly, quarterly, semiannual, and annual frequencies.
2. Maintenance and Service Record: Include manufacturers' forms for recording maintenance.

G. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.

H. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.

I. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.

1. Include procedures to follow and required notifications for warranty claims.

J. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in record Drawings to ensure correct illustration of completed installation.

1. Do not use original project record documents as part of maintenance manuals.

1.10 PRODUCT MAINTENANCE MANUALS

A. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.

B. Content: Organize manual into a separate section for each product, material, and finish. Include source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds, as described below.

C. Source Information: List each product included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.

D. Product Information: Include the following, as applicable:

1. Product name and model number.

2. Manufacturer's name.
3. Color, pattern, and texture.
4. Material and chemical composition.
5. Reordering information for specially manufactured products.

E. Maintenance Procedures: Include manufacturer's written recommendations and the following:

1. Inspection procedures.
2. Types of cleaning agents to be used and methods of cleaning.
3. List of cleaning agents and methods of cleaning detrimental to product.
4. Schedule for routine cleaning and maintenance.
5. Repair instructions.

F. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.

G. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.

1. Include procedures to follow and required notifications for warranty claims.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

SECTION 01 78 39 - PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for Project Record Documents, including the following:

1. Record Drawings.
2. Record Specifications.
3. Record Product Data.
4. Record Shop Drawings.
5. Miscellaneous record submittals.

B. Related Requirements:

1. Section 01 73 00 "Execution" for final property survey.
2. Section 01 77 00 "Closeout Procedures" for general closeout procedures.
3. Section 01 78 23 "Operation and Maintenance Data" for operation and maintenance manual requirements.

1.2 CLOSEOUT SUBMITTALS

A. Record Drawings: Comply with the following:

1. Number of Copies: Submit copies of Record Drawings as follows:

a. Initial Submittal:

1) Submit PDF electronic files of annotated record prints.
2) Architect will indicate whether general scope of changes, additional information recorded, and quality of markups are acceptable.

b. Final Submittal:

1) Submit PDF electronic files of annotated record prints and one (1) full-size hard-copy set printed in color to show markups.
2) Include each drawing, whether or not changes and additional information were recorded.

B. Record Specifications: Submit annotated PDF electronic files of Project's Specifications, including addenda and Contract modifications.

C. Record Product Data: Submit annotated PDF electronic files and directories of each submittal.

1. Where record Product Data are required as part of operation and maintenance manuals, submit duplicate marked-up Product Data as a component of manual.

D. Record Shop Drawings: Submit PDF electronic files of all approved Shop Drawings.

E. Miscellaneous Record Submittals: See other Specification Sections for miscellaneous record-keeping requirements and submittals in connection with various construction activities. Submit annotated PDF electronic files and directories and one (1) paper copy of each submittal.

F. Reports: Submit written report weekly indicating items incorporated into Project Record Documents concurrent with progress of the Work, including revisions, concealed conditions, field changes, product selections, and other notations incorporated.

1.3 RECORD DRAWINGS

A. Record Prints: Maintain one set of annotated PDF copies of the Contract Drawings and Shop Drawings, incorporating new and revised drawings as modifications are issued.

1. Preparation: Annotate record prints to show the actual installation, where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to provide information for preparation of corresponding marked-up record prints.

    a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
    b. Accurately record information in an acceptable drawing technique.
    c. Record data as soon as possible after obtaining it.
    d. Record and check the markup before enclosing concealed installations.
    e. Cross-reference record prints to corresponding photographic documentation.

2. Content: Types of items requiring marking include, but are not limited to, the following:

    a. Dimensional changes to Drawings.
    b. Revisions to details shown on Drawings.
    c. Depths of foundations.
    d. Locations and depths of underground utilities.
    e. Revisions to routing of piping and conduits.
    f. Revisions to electrical circuitry.
    g. Actual equipment locations.
    h. Duct size and routing.
    i. Locations of concealed internal utilities.
    j. Changes made by Change Order or Construction Change Directive.
    k. Changes made following Architect's written orders.
    l. Details not on the original Contract Drawings.
    m. Field records for variable and concealed conditions.
    n. Record information on the Work that is shown only schematically.

3. Annotate the Contract Drawings and Shop Drawings completely and accurately. Use personnel proficient at recording graphic information in production of marked-up record prints.
4. Annotate record prints with red markup tool. Use other colors to distinguish between changes for different categories of the Work at same location.
5. Annotate important additional information that was either shown schematically or omitted from original Drawings.

6. Note Unilateral Change Order numbers, Alternate numbers, Change Order numbers, and similar identification, where applicable.

B. Record Digital Data Files: Immediately before inspection for Certificate of Substantial Completion, review annotated record prints with Architect. When authorized, prepare a full set of corrected digital data files of the Contract Drawings, as follows:

1. Format: Annotated PDF electronic file with comment function enabled.
2. Incorporate changes and additional information previously annotated record prints. Delete, redraw, and add details and notations where applicable.
3. Refer instances of uncertainty to Architect for resolution.
4. Architect will furnish Contractor with one set of digital data files of the Contract Drawings for use in recording information.

    a. See Section 01 31 00 "Project Management and Coordination" for requirements related to use of Architect's digital data files.
    b. Record markups on a unique layer in the PDF file, called “MARKUPS.”

C. Format: Identify and date each Record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.

1. Format: Annotated PDF electronic file with comment function enabled and one (1) set hard-copy prints.
2. Identification: As follows:

    a. Project name:
    b. Date:
    c. Designation "PROJECT RECORD DRAWINGS."
    d. Name of Architect:
    e. Name of Contractor:

3. Record Digital Data Files: Organize digital data information into separate electronic files that correspond to each sheet of the Contract Drawings. Name each file with the sheet identification. In addition, provide electronic files of compiled sheets in volumes consistent with how the original Contract Drawings were issued.
4. Record Prints: Organize record prints into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.

1.4 RECORD SPECIFICATIONS

A. Preparation: Mark Specifications to indicate the actual product installation, where installation varies from that indicated in Specifications, addenda, and Contract modifications.

1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
2. Mark copy with the proprietary name and model number of products, materials, and equipment furnished, including substitutions and product options selected.
3. Record the name of manufacturer, supplier, Installer, and other information necessary to provide a record of selections made.
4. Note related Change Orders, Record Product Data, and Record Drawings where applicable.

B. Format: Submit record specifications as annotated PDF electronic file.

1.5 RECORD PRODUCT DATA

A. Recording: Maintain one copy of each submittal during the construction period for Project Record Document purposes. Post changes and revisions to Project Record Documents as they occur; do not wait until end of Project.

B. Preparation: Mark Product Data to indicate the actual product installation where installation varies substantially from that indicated in Product Data submittal.

1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.
3. Note related Change Orders, Record Specifications, and Record Drawings where applicable.

C. Format: Submit Record Product Data as annotated PDF electronic file.

1. Include Record Product Data directory organized by Specification Section number and title, electronically linked to each item of Record Product Data.

1.6 RECORD SHOP DRAWINGS

A. Maintain one copy of each approved Shop Drawing during the construction period for Project Record Document purposes.

B. Format: Submit Record Shop Drawing as PDF electronic files.

1. Create a separate PDF file for each Specification Division.
2. Bookmark each Shop Drawing for ease of navigation within individual PDF electronic files.

1.7 MISCELLANEOUS SUBMITTALS

A. Assemble miscellaneous records required by other Specification Sections for miscellaneous record keeping and submittal in connection with actual performance of the Work. Bind or file miscellaneous records and identify each, ready for continued use and reference.

1. Include miscellaneous record submittals directory organized by Specification Section number and title, electronically linked to each item of miscellaneous record submittals.

1.8 MAINTENANCE OF RECORD DOCUMENTS

A. Maintenance of Record Documents: Store Record Documents in the field office apart from the Contract Documents used for construction. Do not use Project Record Documents for construction purposes. Maintain Record Documents in good order and in a clean, dry, legible

condition, protected from deterioration and loss. Provide access to Project Record Documents for Architect's reference during normal working hours.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

This page is intentionally left blank.

SECTION 01 79 00 - DEMONSTRATION AND TRAINING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for instructing Owner's personnel, including the following:

1. Instruction in operation and maintenance of systems, subsystems, and equipment.
2. Demonstration and training video recordings.

B. Related Requirements:

1. Section 01 78 23 “Operations and Maintenance Data” for preparation of operations and maintenance manuals, which is a condition precedent to commencement of demonstration and training.
2. Divisions 02 through 33 Sections for specific additional requirements for demonstration and training for products in those Sections.

1.2 INFORMATIONAL SUBMITTALS

A. Instruction Program: Submit outline of instructional program for demonstration and training, including a list of training modules and a schedule of proposed dates, times, length of instruction time, and instructors' names for each training module. Include learning objective and outline for each training module.

1. Indicate proposed training modules using manufacturer-produced demonstration and training video recordings for systems, equipment, and products in lieu of live instructional module.

B. Qualification Data: For instructor.

C. Attendance Record: For each training module, submit list of participants and length of instruction time.

D. Evaluations: For each participant and for each training module, submit results and documentation of performance-based test.

1.3 CLOSEOUT SUBMITTALS

A. Demonstration and Training Video Recordings: Submit two copies within seven days of end of each training module.

1. Identification: On each copy, provide an applied label with the following information:

a. Name of Project.

b. Name and address of videographer.
c. Name of Architect.
d. Name of Construction Manager.
e. Name of Contractor.
f. Date of video recording.

2. Transcript:

a. Prepared in PDF electronic format. Include a cover sheet with same label information as the corresponding video recording and a table of contents with links to corresponding training components. Include name of Project and date of video recording on each page.

3. At completion of training, submit complete training manual(s) for Owner's use prepared in same paper and PDF file format required for operation and maintenance manuals specified in Section 017823 "Operation and Maintenance Data."

1.4 QUALITY ASSURANCE

A. Facilitator Qualifications: A firm or individual experienced in training or educating maintenance personnel in a training program similar in content and extent to that indicated for this Project, and whose work has resulted in training or education with a record of successful learning performance.

B. Instructor Qualifications: A factory-authorized service representative, complying with requirements in Section 01 40 00 "Quality Requirements," experienced in operation and maintenance procedures and training.

C. Videographer Qualifications: A professional videographer who is experienced photographing demonstration and training events similar to those required.

D. Preinstruction Conference: Conduct conference at Project site to comply with requirements in Section 01 31 00 "Project Management and Coordination." Review methods and procedures related to demonstration and training including, but not limited to, the following:

1. Inspect and discuss locations and other facilities required for instruction.
2. Review and finalize instruction schedule and verify availability of educational materials, instructors' personnel, audiovisual equipment, and facilities needed to avoid delays.
3. Review required content of instruction.
4. For instruction that must occur outside, review weather and forecasted weather conditions and procedures to follow if conditions are unfavorable.

1.5 COORDINATION

A. Coordinate instruction schedule with Owner's operations. Adjust schedule as required to minimize disrupting Owner's operations and to ensure availability of Owner's personnel.

B. Coordinate instructors, including providing notification of dates, times, length of instruction time, and course content.

C. Coordinate content of training modules with content of approved emergency, operation, and maintenance manuals. Do not submit instruction program until operation and maintenance data have been reviewed and approved by Architect.

1.6 INSTRUCTION PROGRAM

A. Program Structure: Develop an instruction program that includes individual training modules for each system and for equipment not part of a system, as required by individual Specification Sections.

B. Training Modules: Develop a learning objective and teaching outline for each module. Include a description of specific skills and knowledge that participant is expected to master. For each module, include instruction for the following as applicable to the system, equipment, or component:

1. Basis of System Design, Operational Requirements, and Criteria: Include the following:

    a. System, subsystem, and equipment descriptions.
    b. Performance and design criteria if Contractor is delegated design responsibility.
    c. Operating standards.
    d. Regulatory requirements.
    e. Equipment function.
    f. Operating characteristics.
    g. Limiting conditions.
    h. Performance curves.

2. Documentation: Review the following items in detail:

    a. Emergency manuals.
    b. Systems and equipment operation manuals.
    c. Systems and equipment maintenance manuals.
    d. Product maintenance manuals.
    e. Project Record Documents.
    f. Identification systems.
    g. Warranties and bonds.
    h. Maintenance service agreements and similar continuing commitments.

3. Emergencies: Include the following, as applicable:

    a. Instructions on meaning of warnings, trouble indications, and error messages.
    b. Instructions on stopping.
    c. Shutdown instructions for each type of emergency.
    d. Operating instructions for conditions outside of normal operating limits.
    e. Sequences for electric or electronic systems.
    f. Special operating instructions and procedures.

4. Operations: Include the following, as applicable:

    a. Startup procedures.
    b. Equipment or system break-in procedures.
    c. Routine and normal operating instructions.
    d. Regulation and control procedures.

e. Control sequences.
f. Safety procedures.
g. Instructions on stopping.
h. Normal shutdown instructions.
i. Operating procedures for emergencies.
j. Operating procedures for system, subsystem, or equipment failure.
k. Seasonal and weekend operating instructions.
l. Required sequences for electric or electronic systems.
m. Special operating instructions and procedures.

5. Adjustments: Include the following:

a. Alignments.
b. Checking adjustments.
c. Noise and vibration adjustments.
d. Economy and efficiency adjustments.

6. Troubleshooting: Include the following:

a. Diagnostic instructions.
b. Test and inspection procedures.

7. Maintenance: Include the following:

a. Inspection procedures.
b. Types of cleaning agents to be used and methods of cleaning.
c. List of cleaning agents and methods of cleaning detrimental to product.
d. Procedures for routine cleaning.
e. Procedures for preventive maintenance.
f. Procedures for routine maintenance.
g. Instruction on use of special tools.

8. Repairs: Include the following:

a. Diagnosis instructions.
b. Repair instructions.
c. Disassembly; component removal, repair, and replacement; and reassembly instructions.
d. Instructions for identifying parts and components.
e. Review of spare parts needed for operation and maintenance.

1.7 PREPARATION

A. Assemble educational materials necessary for instruction, including documentation and training module. Assemble training modules into a training manual organized in coordination with requirements in Section 01 78 23 "Operation and Maintenance Data."

B. Set up instructional equipment at instruction location.

1.8 INSTRUCTION

A. Facilitator: Engage a qualified facilitator to prepare instruction program and training modules, to coordinate instructors, and to coordinate between Contractor and Owner for number of participants, instruction times, and location.

B. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.

C. Scheduling: Provide instruction at mutually agreed-on times. For equipment that requires seasonal operation, provide similar instruction at start of each season.

1. Schedule training with Owner with at least 14 days' advance notice.

D. Training Location and Reference Material: Conduct training on-site in the completed and fully operational facility using the actual equipment in-place. Conduct training using final operation and maintenance data submittals.

E. Evaluation: At conclusion of each training module, assess and document each participant's mastery of module by use of a demonstration performance-based test.

F. Cleanup: Collect used and leftover educational materials and give to Owner. Remove instructional equipment. Restore systems and equipment to condition existing before initial training use.

1.9 DEMONSTRATION AND TRAINING VIDEO RECORDINGS

A. General: Coordinate with Owner contracted commercial videographer to record demonstration and training video recordings. Record each training module separately. Include classroom instructions and demonstrations, board diagrams, and other visual aids, but not student practice.

1. At beginning of each training module, record each chart containing learning objective and lesson outline.

B. Digital Video Recordings: Provide high-resolution, digital video in MPEG format, produced by a digital camera with minimum sensor resolution of 12 megapixels and capable of recording in full HD mode with vibration reduction technology.

1. Submit video recordings on DVD or thumb drive and by uploading to web-based Project software site.
2. File Hierarchy: Organize folder structure and file locations in accordance with Project Manual table of contents. Provide complete screen-based menu.
3. File Names: Utilize file names based on name of equipment generally described in video segment, as identified in Project specifications.
4. Contractor and Installer Contact File: Using appropriate software, create a file for inclusion on the equipment demonstration and training recording that describes the following for each Contractor involved on the Project, arranged in accordance with Project Manual table of contents:

a. Name of Contractor/Installer.
b. Business address.

c. Business phone number.
d. Point of contact.
e. Email address.

C. Recording: Mount camera on tripod before starting recording, unless otherwise necessary to adequately cover area of demonstration and training. Display continuous running time.

1. Film training session(s) in segments not to exceed 15 minutes.

a. Produce segments to present a single significant piece of equipment per segment.
b. Organize segments with multiple pieces of equipment to follow order of Project Manual table of contents.
c. Where a training session on a particular piece of equipment exceeds 15 minutes, stop filming and pause training session. Begin training session again upon commencement of new filming segment.

D. Light Levels: Verify light levels are adequate to properly light equipment. Verify equipment markings are clearly visible prior to recording.

1. Furnish additional portable lighting as required.

E. Narration: Describe scenes on video recording by audio narration by microphone while and dubbing audio narration off-site after video recording is recorded, as required for clarity. Include description of items being viewed.

F. Transcript: Provide a transcript of the narration. Display images and running time captured from videotape opposite the corresponding narration segment.

G. Preproduced Video Recordings: Provide video recordings used as a component of training modules in same format as recordings of live training.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

SECTION 01 81 13.14 - SUSTAINABLE DESIGN REQUIREMENTS - LEED V4 BD+C: NEW CONSTRUCTION

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes general requirements and procedures for compliance with USGBC's LEED prerequisites and credits needed for Project to obtain LEED Silver certification based on USGBC's "LEED Version 4 for Building Design and Construction" (hereafter, LEED v4 BD+C).

1. Specific requirements for LEED are also included in other Sections.
2. Other LEED prerequisites and credits needed to obtain LEED certification depend on product selections and may not be specifically identified as LEED requirements. Compliance with requirements needed to obtain LEED prerequisites and credits may be used as one criterion to evaluate substitution requests and comparable product requests.
3. Project opts to meet LEEDv4.1 criteria as allowed by the USGBC, for certain Credits included in other Sections.
4. A copy of LEED Project checklist is attached at end of this Section for information only.

    a. Some LEED prerequisites and credits needed to obtain indicated LEED certification depend on Architect's design and other aspects of Project that are not part of the Work of the Contract.

1.2 DEFINITIONS

A. BUG Rating: Classification system for luminaires defined in terms of backlight (B), uplight (U), and glare (G).

B. Chain-of-Custody Certificates: Certificates signed by manufacturers certifying that wood used to make products was obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001. Certificates shall include evidence that manufacturer is certified for chain of custody by an FSC-accredited certification body.

C. Cradle-to-Gate Assessment: Analysis of a product's partial life-cycle from extraction (cradle) to gate (factory completion prior to distribution).

D. LEED: USGBC's "LEED Version 4 for Building Design and Construction." Definitions that are part of this document apply to this Section.

E. Life-Cycle Assessment: Evaluation of environmental impacts of a product from cradle to gate, defined by ISO 14040 and ISO 14044.

F. Life-Cycle Inventory: Database that defines environmental input and output for each step in a material or assembly's life cycle.

G. Recycled Content: The recycled content value of a material assembly shall be determined by weight. The recycled fraction of the assembly is then multiplied by the cost of assembly to determine the recycled content value.

1. "Postconsumer" material is defined as waste material generated by households or by commercial, industrial, and institutional facilities in their role as end users of the product, which can no longer be used for its intended purpose.
2. "Preconsumer" material is defined as material diverted from the waste stream during the manufacturing process. Reutilization of materials (such as rework, regrind, or scrap generated in a process and capable of being reclaimed within the same process that generated it) is excluded.

H. Regional Materials: Materials that have been extracted, harvested, or recovered, as well as manufactured, within 100 miles of Project site. If only a fraction of a product or material is extracted/harvested/recovered and manufactured locally, then only that percentage (by weight) shall contribute to the regional value.

I. Solar Reflectance Index (SRI): The measure of a constructed surface's ability to stay cool in the sun by reflecting solar radiation and emitting thermal radiation. SRI values range from zero (solid black surface) to 100 (solid white surface). SRI value of a material is calculated according to ASTM E1980 and based on the aged-tested values of solar reflectance and thermal emittance.

J. Vertical Illuminance: Illuminance levels calculated at a point on a vertical service or plane.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site. Review LEED requirements and action plans for compliance with requirements.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Respond to questions and requests from Architect about USGBC's LEED prerequisites and credits that are Contractor's responsibility, that depend on product selection or product qualities, or that depend on Contractor's procedures, until USGBC has made its determination on Project's LEED certification application.

1.5 ACTION SUBMITTALS

A. General: Submit sustainable design submittals required by other Sections.

B. Submittal Service: Use a cloud-based LEED system submittal service for all LEED submittals.

1. Basis-of-Design Service: Subject to compliance with requirement, provide submittals through Green Badger LEED Documentation Software or comparable product service.

C. Sustainable design submittals are in addition to other submittals.

1. If submitted item is identical to that proposed to comply with other requirements, include additional copy with other submittal as a record of compliance with indicated LEED requirements instead of separate sustainable design submittal. Mark additional copy "Sustainable design submittal."

D. Sustainable Design Documentation Submittals:

1. Documentation for luminaires indicating BUG ratings, lumens emitted, and vertical illuminance values.
2. Documentation for compliant paving materials indicating the SRI, SR, and permeability.
3. Documentation for compliant roofing materials indicating the SRI.
4. Product Data and certification for WaterSense-labeled water fixtures.
5. Product Data for plumbing fixtures indicating flush or flow rate.
6. Environmental Product Declarations (EPDs) complying with LEED requirements under MR Credit: Environmental Product Declarations Option 1.
7. Documentation for products that comply with LEED requirements for Embodied Carbon/LCA Optimization under MR Credit: Environmental Product Declarations Option 2.

    a. Include documentation for any applicable third-party certifications.

8. Documentation for products that comply with LEED requirements for leadership extraction practices. Include the following:

    a. Product Data and certification letter from product manufacturers, indicating participation in an extended producer responsibility program and statement of costs.
    b. Product Data and certification for bio-based materials, indicating that they comply with requirements. Include statement of costs.
    c. Product Data and chain-of-custody certificates for products containing certified wood. Include invoices for all wood products.
    d. Receipts for salvaged and refurbished materials used for Project, indicating sources and costs.
    e. Product Data and certification letter from product manufacturers, indicating percentages by weight of postconsumer and preconsumer recycled content for products having recycled content. Include statement of costs.
    f. Documentation for regional materials, indicating location and distance from Project of material manufacturer and point of extraction, harvest, or recovery for each raw material and costs of regional materials.

9. Material ingredient reports for products that comply with LEED requirements for material ingredient reporting.
10. Documentation for products that comply with LEED requirements for material ingredient optimization.

    a. Include documentation for regional materials, indicating location and distance from Project of material manufacturer and point of extraction, harvest, or recovery for each raw material and costs of regional materials.

11. Documentation complying with Section 01 74 19 "Construction Waste Management and Disposal."
12. Product Data for adhesives and sealants used inside weatherproofing system, indicating VOC content and laboratory test reports showing compliance with requirements for low-emitting materials. Include statement of costs.
13. Product Data for paints and coatings used inside weatherproofing system, indicating VOC content and laboratory test reports showing compliance with requirements for low-emitting materials. Include statement of costs.

14. Laboratory test reports for flooring, indicating compliance with requirements for low-emitting materials. Include statement of costs.
15. Laboratory test reports for products containing composite wood or agrifiber products or wood glues, indicating compliance with requirements for low-emitting materials. Include statement of costs.
16. Laboratory test reports for ceilings, walls, and thermal insulation, indicating compliance with requirements for low-emitting materials. Include statement of costs.
17. Construction Indoor-Air-Quality (IAQ) Management:

    a. Construction IAQ management plan.
    b. Product Data for temporary filtration media.
    c. Product Data for filtration media used during occupancy.
    d. Construction Documentation: Six photographs at three different times during construction period, along with brief description of SMACNA approach employed, documenting implementation of IAQ management measures, including protection of ducts and on-site stored or installed absorptive materials.

18. IAQ Assessment:

    a. Signed statement describing the building air flush-out procedures, including dates when flush-out was begun and completed and statement that filtration media was replaced after flush-out.
    b. Product Data for filtration media used during flush-out and occupancy.
    c. Report from testing and inspecting agency indicating results of IAQ testing and documentation that show compliance with IAQ testing procedures and requirements.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Sustainability Consultant.

B. Project Materials Cost Data: Provide statement indicating total cost for materials used for Project. Costs exclude labor, overhead, and profit. Include breakout of costs for the following categories of items:

1. Plumbing.
2. Mechanical.
3. Electrical.
4. Specialty items such as elevators and equipment.
5. Millwork.

C. Sustainable Design Action Plans: Provide preliminary submittals within 30 days of date established for the Notice to Proceed, indicating how the following requirements will be met:

1. List of proposed products with EPDs.
2. List of proposed products complying with requirements for Embodied Carbon/LCA .
3. List of proposed products complying with requirements for raw material and source extraction reporting.
4. List of proposed products complying with requirements for material ingredient reporting.
5. List of proposed products complying with requirements for material ingredient optimization.

6. Waste management plan complying with Section 01 74 19 "Construction Waste Management and Disposal."
7. Construction IAQ management plan.

D. Sustainable Design Progress Reports: Concurrent with each Application for Payment, submit reports comparing actual construction and purchasing activities with sustainable design action plans.

1.7 QUALITY ASSURANCE

A. Sustainability Consultant: Engage an experienced LEED Accredited Professional to coordinate LEED requirements. Sustainability Consultant may also serve as waste management coordinator.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Provide products and procedures necessary to obtain LEED credits indicated as Contractor's responsibility. Although other Sections may specify some requirements that contribute to these LEED credits, Contractor shall provide additional materials and procedures necessary to obtain LEED credits indicated.

B. At least 20 different products from at least five different manufacturers shall have EPDs that comply with LEED requirements. Industrywide (generic) EPDs shall be valued as one-half of a product.

C. At least 5 permanently installed products sourced from at least three different manufacturers for Project shall comply with LEED requirements for Embodied Carbon/LCA optimization.

D. At least 20 different products from at least five different manufacturers shall comply with LEED requirements for material ingredient reporting.

E. At least at least 5 permanently installed products sourced from at least three different manufacturers for Project shall comply with LEED requirements for material ingredient optimization.

F. Not less than 15 percent of building materials, by cost, shall comply with LEED requirements for responsible sourcing of raw materials.

G. Recycled Content: Building materials shall have recycled content such that postconsumer recycled content plus one-half of preconsumer recycled content for Project constitutes a minimum of 75 percent of cost of materials used for Project.

1. Cost of postconsumer recycled content plus one-half of preconsumer recycled content of an item shall be determined by dividing weight of postconsumer recycled content plus one-half of preconsumer recycled content in the item by total weight of the item and multiplying by cost of the item.
2. Do not include furniture, plumbing, mechanical and electrical components, and specialty items, such as elevators and equipment, in the calculation.

H. Certified Wood: Not less than 50 percent, by cost, of wood-based materials shall be produced from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001.

2.2 LOW-EMITTING MATERIALS

A. Paints and Coatings: For field applications that are inside the weatherproofing system, paints and coatings shall comply with VOC content limits of authorities having jurisdiction and the following VOC content limits:

1. Flat Paints and Coatings: 50 g/L.
2. Nonflat Paints and Coatings: 100 g/L.
3. High Gloss Paints and Coatings: 150 g/L
4. Dry-Fog Coatings: 150 g/L.
5. Primers, Sealers, and Undercoaters: 100 g/L.
6. Rust-Preventive Coatings: 100 g/L.
7. Zinc-Rich Industrial Maintenance Primers: 100 g/L.
8. Pretreatment Wash Primers: 420 g/L.
9. Clear Wood Finishes, Varnishes: 275 g/L.
10. Clear Wood Finishes, Lacquers: 275 g/L.
11. Floor Coatings: 50 g/L.
12. Shellacs, Clear: 730 g/L.
13. Shellacs, Pigmented: 550 g/L.
14. Stains: 100 g/L.

B. Paints and Coatings: For field applications that are inside the weatherproofing system, 90 percent of paints and coatings shall comply with requirements of California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

C. Adhesives and Sealants: For field applications that are inside the weatherproofing system, adhesives and sealants shall comply with VOC content limits of authorities having jurisdiction and the following VOC content limits:

1. Wood Glues: 30 g/L.
2. Metal-to-Metal Adhesives: 30 g/L.
3. Adhesives for Porous Materials (except Wood): 50 g/L.
4. Subfloor Adhesives: 50 g/L.
5. Plastic Foam Adhesives: 50 g/L.
6. Carpet Adhesives: 50 g/L.
7. Carpet Pad Adhesives: 50 g/L.
8. VCT and Asphalt Tile Adhesives: 50 g/L.
9. Cove Base Adhesives: 50 g/L.
10. Gypsum Board and Panel Adhesives: 50 g/L.
11. Rubber Floor Adhesives: 60 g/L.
12. Ceramic Tile Adhesives: 65 g/L.
13. Multipurpose Construction Adhesives: 70 g/L.
14. Fiberglass Adhesives: 80 g/L.
15. Contact Adhesives: 80 g/L.
16. Structural Glazing Adhesives: 100 g/L.
17. Wood Flooring Adhesives: 100 g/L.
18. Structural Wood Member Adhesives: 140 g/L.

19. Single-Ply Roof Membrane Adhesives: 250 g/L.
20. Special-Purpose Contact Adhesives (That Are Used to Bond Melamine-Covered Board, Metal, Unsupported Vinyl, Rubber, or Wood Veneer 1/16 Inch or Less in Thickness to Any Surface): 250 g/L.
21. Top and Trim Adhesives: 250 g/L.
22. Plastic Cement Welding Compounds: 250 g/L.
23. ABS Welding Compounds: 325 g/L.
24. CPVC Welding Compounds: 490 g/L.
25. PVC Welding Compounds: 510 g/L.
26. Adhesive Primer for Plastic: 550 g/L.
27. Sheet-Applied Rubber Lining Adhesives: 850 g/L.
28. Aerosol Adhesive, General-Purpose Mist Spray: 65 percent by weight.
29. Aerosol Adhesive, General-Purpose Web Spray: 55 percent by weight.
30. Special-Purpose Aerosol Adhesives (All Types): 70 percent by weight.
31. Other Adhesives: 250 g/L.
32. Architectural Sealants: 250 g/L.
33. Nonmembrane Roof Sealants: 300 g/L.
34. Single-Ply Roof Membrane Sealants: 450 g/L.
35. Other Sealants: 420 g/L.
36. Sealant Primers for Nonporous Substrates: 250 g/L.
37. Sealant Primers for Porous Substrates: 775 g/L.
38. Modified Bituminous Sealant Primers: 500 g/L.
39. Other Sealant Primers: 750 g/L.

D. Adhesives and Sealants: For field applications that are inside the weatherproofing system, 90 percent of adhesives and sealants shall comply with requirements of California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

E. Flooring: Shall comply with requirements of California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

F. Composite Wood, Agrifiber Products, and Adhesives: Shall be made using ultra-low-emitting formaldehyde resins as defined in California Air Resources Board's "Airborne Toxic Control Measure to Reduce Formaldehyde Emissions from Composite Wood Products" or shall be made with no added formaldehyde.

G. Ceilings, Walls, and Thermal Insulation: Shall comply with requirements of California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

PART 3 - EXECUTION

3.1 NONSMOKING BUILDING

A. Smoking is not permitted within the building or within 25 ft. of entrances, operable windows, or outdoor-air intakes.

3.2 CONSTRUCTION WASTE MANAGEMENT

A. Comply with Section 01 74 19 "Construction Waste Management and Disposal."

3.3 CONSTRUCTION INDOOR-AIR-QUALITY (IAQ) MANAGEMENT

A. Comply with SMACNA's "SMACNA IAQ Guideline for Occupied Buildings under Construction."

1. If Owner authorizes use of permanent heating, cooling, and ventilating systems during construction period as specified in Section 01 50 00 "Temporary Facilities and Controls," install MERV 8 filter media at each return-air inlet for the air-handling system used during construction.

    a. Replace air filters immediately prior to occupancy with new filters specified in Section 23 40 00 "Air Cleaning."
    b. Seal all ductwork, registers, diffusers, and returns with plastic when stored on site or not in service. Seal unfinished runs of ductwork at the end of each day.
    c. Do not store materials in mechanical rooms, to reduce potential debris and contamination to mechanical systems

2. Source control: Keep sources of contaminants out of the building and have a plan to eliminate any that are introduced.

    a. Use low-toxicity and low-VOC materials to the greatest extent possible.
    b. Develop protocols for the use of any high-toxicity materials. Isolate areas where high-toxicity materials are being installed and use temporary ventilation for that area.
    c. Prevent exhaust fumes (from idling vehicles, equipment, and fossil-fueled tools) from entering the building.
    d. Enforce the no-smoking job site policy.
    e. Protect stored materials from moisture because absorbent materials exposed to moisture during construction can mold and degenerate long after installation. Store materials in dry conditions indoors, under cover, and off the ground or floor.
    f. If materials are improperly exposed to moisture, replace the material and consider testing air quality before occupancy to make sure no mold contamination has occurred.

3. Pathway interruption. Prevent circulation of contaminated air when cutting concrete or wood, sanding drywall, installing VOC-emitting materials, or performing other activities that affect IAQ in other work spaces.

    a. Isolate areas of work to prevent contamination of other spaces, whether they are finished or not. Seal doorways, windows, or tent off areas as needed using temporary barriers, such as plastic separations. Provide walk-off mats at entryways to reduce introduced dirt and pollutants.
    b. Depressurize the work area to allow a differential between construction areas and clean areas. Exhaust to the outdoors using 100% outdoor air, if possible.
    c. Use dust guards and collectors on saws and other tools.

4. Housekeeping. Maintaining a clean job site results in fewer IAQ contaminants to manage

a. Maintain good job site housekeeping on a daily basis. Use vacuum cleaners with high-efficiency particulate filters and use sweeping compounds or wetting agents for dust control when sweeping.
b. Keep materials organized to improve job site safety as well as indoor air quality.

5. Scheduling. Sequence construction activities to reduce air quality problems in new construction projects. For major renovations, coordinate construction activities to minimize or eliminate disruption of operations in occupied areas.

a. Keep trades that affect IAQ physically isolated on site and separated from each other by the construction schedule. For example, schedule drywall finishing and carpet installation for different days or different sections of the building. Consider after-hours or weekend work if practical.
b. Install absorptive-finish materials after wet-applied materials have fully cured whenever possible.
c. If applicable, plan adequate time to conduct a flush-out and/or perform IAQ testing before occupancy, in compliance with EQ Credit Indoor Air Quality Assessment
d. Remove all temporary filtration media and replace them with new filters before occupancy.

3.4 INDOOR-AIR-QUALITY (IAQ) ASSESSMENT

A. Flush-Out:

1. After construction ends, prior to occupancy and with all interior finishes installed, perform a building flush-out by supplying a total volume of 14,000 cu. ft. of outdoor air per sq. ft. of floor area while maintaining an internal temperature of at least 60 deg F and a relative humidity no higher than 60 percent.

2. If occupancy is desired prior to flush-out completion, the space may be occupied following delivery of a minimum of 3500 cu. ft. of outdoor air per sq. ft. of floor area to the space. Once a space is occupied, it shall be ventilated at a minimum rate of 0.30 cfm per sq. ft. of outside air or the design minimum outside air rate, whichever is greater. During each day of the flush-out period, ventilation shall begin a minimum of three hours prior to occupancy and continue during occupancy. These conditions shall be maintained until a total of 14,000 cu. ft./sq. ft. of outside air has been delivered to the space.

B. Air-Quality Testing: Engage testing agency to perform the following:

1. Conduct baseline IAQ testing, after construction ends and prior to occupancy, using testing protocols consistent with the EPA's "Compendium of Methods for the Determination of Air Pollutants in Indoor Air," and as additionally detailed in USGBC's "LEED Reference Guide for Building Design and Construction v4."
2. Demonstrate that contaminant maximum concentrations listed below are not exceeded:

a. Formaldehyde: 27 ppb.
b. Particulates (PM10): 50 mcg/cu. m.
c. Ozone: 0.075 ppm, according to ASTM D5149.
d. Total Volatile Organic Compounds (TVOC): 500 mcg/cu. m.
e. 4-Phenylcyclohexene (4-PH): 6.5 mcg/cu. m.
f. Carbon Monoxide: 9 ppm and no greater than 2 ppm above outdoor levels.

g. Target Chemicals in California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers," Table 4-1 (except formaldehyde).

3. For each sampling point where maximum concentration limits are exceeded, take corrective action until requirements have been met.
4. Air-sample testing shall be conducted as follows:

   a. All measurements shall be conducted prior to occupancy but during normal occupied hours, and with building ventilation system starting at the normal daily start time and operated at the minimum outside airflow rate for the occupied mode throughout the duration of the air testing.
   b. Building shall have all interior finishes installed including, but not limited to, millwork, doors, paint, carpet, and acoustic tiles. Nonfixed furnishings such as workstations and partitions are encouraged, but not required, to be in place for the testing.
   c. Number of sampling locations varies depending on the size of building and number of ventilation systems. For each portion of building served by a separate ventilation system, the number of sampling points shall not be less than one per 5000 sq. ft.. For large open spaces, one sampling point per 50,000 sq. ft. may be used.
   d. Air samples shall be collected between 3 and 6 ft. from the floor to represent the breathing zone of occupants, and over a minimum four-hour period.

END OF SECTION

01 81 13.14A – LEED MATRIX - APPENDIX A

Legend:
a = review for accessory materials
m = mandatory; spec should require LEED submittal
n/a = not applicable
p = LEED submittal is preferred if available
• = pursuit TBD

SECTION NUMBER	SECTION TITLE	Consultant	ISSUE NUMBER					
			EPD	Multi-Attribute Optimization	Sourcing of Raw Materials	Material Ingredient Reporting	Material Ingredient Optimization	Low-Emitting Materials
			MRc2 Option 1	MRc2 Option 2*	MRc3*	MRc4 Option 1	MRc4. Option 2*	IEQc2
DIVISION 02 – EXISTING CONDITIONS								
02 41 19	Selective Demolition	FA	n/a	n/a	n/a	n/a	n/a	n/a
DIVISION 03 – CONCRETE								
03 10 00	Concrete Forming and Accessories	HFA	n/a	n/a	n/a	n/a	n/a	n/a
03 30 00	Cast-in-Place Concrete	HFA	m	p	m	p	p	n/a
03 45 00	Precast Architectural Concrete	FA	m	p	m	p	p	n/a
DIVISION 04 – MASONRY								
04 01 40.99	Relocation Reuse and Restoration of Latrobe Marble Columns	FA	n/a	n/a	m	n/a	n/a	n/a
04 22 00	Concrete Unit Masonry	FA	m	p	m	p	p	n/a
DIVISION 05 - METALS								
05 12 00	Structural Steel Framing	HFA	m	p	m	p	p	n/a
05 31 00	Steel Decking	HFA	m	p	m	p	p	n/a
05 40 00	Cold-Formed Metal Framing	FA	m	p	m	p	p	n/a

SECTION NUMBER	SECTION TITLE	Consultant	ISSUE NUMBER					
			EPD	Multi-Attribute Optimization	Sourcing of Raw Materials	Material Ingredient Reporting	Material Ingredient Optimization	Low-Emitting Materials
			MRc2 Option 1	MRc2 Option 2*	MRc3*	MRc4 Option 1	MRc4. Option 2*	IEQc2
05 50 00	Metal Fabrications	FA	m	p	m	p	p	n/a
05 51 13	Metal Pan Stairs	FA	m	p	m	p	p	n/a
05 53 13	Bar Gratings	HFA	p	p	p	p	p	n/a
05 58 13	Column Covers	FA	p	p	p	p	p	n/a
05 70 00	Decorative Metal	FA	p	p	p	p	p	n/a
05 71 00	Decorative Metal Stairs	FA	m	p	m	p	p	n/a
05 73 00	Decorative Metal Railings	FA	m	p	m	p	p	n/a
05 73 13	Glazed Decorative Metal Railings	FA	p	p	p	p	p	n/a
05 75 00	Decorative Formed Metal	FA	m	p	m	p	p	n/a
DIVISION 06 – WOOD, PLASTICS, AND COMPOSITES								
06 01 40.99	Relocation Reuse and Restoration of Historic Courtroom Woodwork	FA	n/a	n/a	m	n/a	n/a	n/a
06 10 00	Rough Carpentry	FA	p	p	m	p	p	n/a
06 16 00	Sheathing	FA	p	p	m	p	p	m
06 40 23	Interior Architectural Woodwork	FA	p	p	m	p	p	m
06 41 13	Wood-Veneer-Faced Architectural Cabinets	FA	p	p	m	p	p	m, a
06 41 16	Plastic-Laminate-Clad Architectural Cabinets	FA	p	p	m	m	p	m, a
06 42 14	Stile and Rail Wood Paneling	FA	p	p	m	p	p	m, a
06 44 00	Ornamental Woodwork	FA	p	p	m	p	p	m, a
06 64 00	Plastic Paneling	FA	p	p	m	p	p	m, a

SECTION NUMBER	SECTION TITLE	Consultant	ISSUE NUMBER					
			EPD	Multi-Attribute Optimization	Sourcing of Raw Materials	Material Ingredient Reporting	Material Ingredient Optimization	Low-Emitting Materials
			MRc2 Option 1	MRc2 Option 2*	MRc3*	MRc4 Option 1	MRc4. Option 2*	IEQc2
06 83 13	Fiber-Reinforced Plastic Paneling	FA	p	p	m	p	p	m, a
DIVISION 07 – THERMAL AND MOISTURE PROTECTION								
07 05 43.13	Rainscreen Cladding Support Systems	FA	p	p	m	p	p	m, a
07 11 13	Bituminous Dampproofing	FA	p	p	m	p	p	m, a
07 13 26	Self-Adhering Sheet Waterproofing	FA	p	p	m	p	p	m, a
07 14 13	Hot Fluid-Applied Rubberized Asphalt Waterproofing	FA	p	p	m	p	p	m, a
07 16 16	Crystalline Waterproofing	FA	p	p	m	p	p	m, a
07 18 00	Traffic Coatings	FA	p	p	m	p	p	m, a
07 19 00	Water Repellents	FA	p	p	m	p	p	m, a
07 21 00	Thermal Insulation	FA	p	p	m	p	p	m, a
07 21 19	Foamed-In-Place Insulation	FA	p	p	m	p	p	m, a
07 27 13	Modified Bituminous Sheet Air Barriers	FA	p	p	m	p	p	m, a
07 42 13.13	Formed Metal Wall Panels	FA	p	p	m	p	p	m, a
07 54 19	Polyvinyl-Chloride (PVC) Roofing	FA	p	p	m	p	p	n/a
07 62 00	Sheet Metal Flashing and Trim	FA	p	n/a	p	n/a	n/a	n/a
07 72 00	Roof Accessories	FA	p	n/a	n/a	n/a	n/a	n/a
07 72 73	Vegetated Roof Systems	FA	p	n/a	p	n/a	n/a	n/a
07 81 00	Applied Fire Protection	FA	p	p	p	p	p	m
07 84 13	Penetration Firestopping	FA	p	p	p	p	p	m

SECTION NUMBER	SECTION TITLE	Consultant	ISSUE NUMBER					
			EPD	Multi-Attribute Optimization	Sourcing of Raw Materials	Material Ingredient Reporting	Material Ingredient Optimization	Low-Emitting Materials
			MRc2 Option 1	MRc2 Option 2*	MRc3*	MRc4 Option 1	MRc4. Option 2*	IEQc2
07 84 43	Joint Firestopping	FA	p	p	p	p	p	m
07 92 00	Joint Sealants	FA	p	p	p	p	p	m
07 92 19	Acoustical Joint Sealants	FA	p	p	p	p	p	m
DIVISION 08 – OPENINGS								
08 11 13	Hollow Metal Doors and Frames	FA	m	p	m	p	p	m, a
08 14 16	Flush Wood Doors	FA	m	p	m	p	p	m, a
08 14 33	Stile and Rail Wood Doors	FA	m	p	m	p	p	m, a
08 31 13	Access Doors and Frames	FA	m	p	m	p	p	m, a
08 33 23	Overhead Coiling Doors	FA	m	p	m	p	p	m, a
08 33 43	Overhead Coiling Smoke Curtains	FA	p	n/a	n/a	p	n/a	n/a
08 44 13	Glazed Aluminum Curtain Walls	FA	m	p	m	p	p	m, a
08 56 53	Security Windows	FA	m	p	m	p	p	m, a
08 63 00	Metal-Framed Skylights	FA	m	p	m	p	p	m, a
08 71 00	Door Hardware	DMK/FA	m	p	m	p	p	p
08 71 13	Power Door Operators	FA	p	p	p	p	p	p
08 75 16	Window Operators	FA	p	p	p	p	p	p
08 80 00	Glazing	FA	p	p	m	p	p	m, a
08 81 13	Decorative Glass Glazing	FA	p	p	m	p	p	m, a
08 83 00	Mirrors	FA	n/a	n/a	n/a	n/a	n/a	m, a
08 88 53	Security Glazing	FA	p	p	m	p	p	m, a

SECTION NUMBER	SECTION TITLE	Consultant	ISSUE NUMBER					
			EPD	Multi-Attribute Optimization	Sourcing of Raw Materials	Material Ingredient Reporting	Material Ingredient Optimization	Low-Emitting Materials
			MRc2 Option 1	MRc2 Option 2*	MRc3*	MRc4 Option 1	MRc4. Option 2*	IEQc2
08 91 19	Fixed Louvers	FA	p	p	m	p	p	p
DIVISION 09 - FINISHES								
09 05 61.13	Moisture Vapor Emission Control	FA	p	p	p	p	p	m
09 21 16.23	Gypsum Board Shaft Wall Assemblies	FA	m	p	m	m	p	m
09 22 16	Non-Structural Metal Framing	FA	m	p	m	p	p	m
09 23 13	Acoustical Gypsum Plastering	FA	m	p	m	m	p	m
09 24 00	Cement Plastering	FA	m	p	m	m	p	m
09 27 13	Glass-Fiber-Reinforced Gypsum Fabrications	FA	m	p	m	p	p	m
09 29 00	Gypsum Board	FA	m	p	m	m	p	m
09 30 13	Ceramic Tiling	FA	m	p	m	m	p	m
09 51 13	Acoustical Panel Ceilings	FA	m	p	m	m	p	m
09 64 00	Wood Flooring	FA	m	p	m	m	p	m
09 65 13	Resilient Base and Accessories	FA	m	p	m	m	p	m
09 65 19	Resilient Tile Flooring	FA	m	p	m	m	p	m
09 65 36	Static-Control Resilient Flooring	FA	m	p	m	m	p	m
09 65 66	Resilient Athletic Flooring	FA	m	p	m	m	p	m
09 66 23	Resinous Matrix Terrazzo Flooring	FA	m	p	m	m	p	m
09 68 13	Tile Carpeting	FA	m	p	m	m	p	m
09 75 13	Stone Wall Facing	FA	p	n/a	p	n/a	n/a	n/a

SECTION NUMBER	SECTION TITLE	Consultant	ISSUE NUMBER					
			EPD	Multi-Attribute Optimization	Sourcing of Raw Materials	Material Ingredient Reporting	Material Ingredient Optimization	Low-Emitting Materials
			MRc2 Option 1	MRc2 Option 2*	MRc3*	MRc4 Option 1	MRc4. Option 2*	IEQc2
09 75 23	Simulated Stone Wall Facing	FA	p	n/a	p	p	n/a	m
09 84 33	Sound-Absorbing Wall Units	FA	p	p	m	p	p	m
09 91 23	Interior Painting	FA	m	p	m	m	p	m
09 96 11	High-Performance Coatings (Proprietary Specification)	FA	m	p	m	m	p	m
DIVISION 10 - SPECIALTIES								
10 14 00	Signage	FA	p	n/a	p	p	n/a	m
10 21 13.17	Phenolic-Core Toilet Compartments	FA	m	p	m	p	p	m, a
10 22 13	Wire Mesh Partitions	FA	m	p	m	p	p	m, a
10 22 39	Folding Panel Partitions	FA	m	p	m	p	p	m, a
10 26 00	Wall and Door Protection	FA	m	p	m	m	p	m, a
10 26 41	Bullet Resistant Panels	FA	p	p	p	p	p	p
10 28 00	Toilet, Bath, and Laundry Accessories	FA	n/a	n/a	n/a	n/a	n/a	n/a
10 43 13	Defibrillator Cabinets	FA	n/a	n/a	n/a	n/a	n/a	n/a
10 44 13	Fire Protection Cabinets	FA	n/a	n/a	n/a	n/a	n/a	n/a
10 44 16	Fire Extinguishers	FA	n/a	n/a	n/a	n/a	n/a	n/a
10 45 13	Photoluminescent Egress Path Markings	FA	n/a	n/a	n/a	n/a	n/a	m
10 51 13	Metal Lockers	FA	p	p	p	p	p	m
10 51 16	Wood Lockers	FA	p	p	p	p	p	m
10 51 23	Plastic-Laminate-Clad Lockers	FA	p	p	p	p	p	m

SECTION NUMBER	SECTION TITLE	Consultant	ISSUE NUMBER					
			EPD	Multi-Attribute Optimization	Sourcing of Raw Materials	Material Ingredient Reporting	Material Ingredient Optimization	Low-Emitting Materials
			MRc2 Option 1	MRc2 Option 2*	MRc3*	MRc4 Option 1	MRc4. Option 2*	IEQc2
DIVISION 11 – EQUIPMENT								
11 12 00	Vehicle Access Control Systems	M2H	n/a	n/a	n/a	n/a	n/a	n/a
11 13 19	Stationary Loading Dock Equipment	FA	n/a	n/a	n/a	n/a	n/a	n/a
11 19 16	Detention Gun Lockers	FA	n/a	n/a	n/a	n/a	n/a	n/a
11 30 13	Residential Appliances	FA	n/a	n/a	n/a	n/a	n/a	n/a
11 81 31	Facility Fall Protection and Facade Access Equipment	FA	n/a	n/a	n/a	n/a	n/a	n/a
11 81 33	Mobile Scissor Lifts	FA	n/a	n/a	n/a	n/a	n/a	n/a
DIVISION 12 – FURNISHINGS								
12 24 13	Roller Window Shades	FA	p	p	p	p	p	m, a
12 36 23.13	Plastic-Laminate-Clad Countertops	FA	p	p	m	m	p	m, a
12 36 61.19	Quartz Agglomerate Countertops	FA	p	p	m	m	p	m, a
12 93 00	Site Furnishings	RHI	p	n/a	p	p	n/a	n/a
DIVISION 14 – CONVEYING EQUIPMENT								
14 21 23.16	Machine Room-Less Electric Traction Passenger Elevators	FA	n/a	n/a	n/a	n/a	n/a	n/a
14 27 00	Custom Elevator Cabs and Doors	FA	n/a	n/a	n/a	n/a	n/a	n/a

END OF SECTION

This page is intentionally left blank.

					LEEDv4 for New Construction and Major Renovations						
					Project Checklist		**Supreme Court of Maryland**				**Silver minimum**
											17-Mar-23
Y	SM	M	N								
1			**0**	D	**Integrated Process**		Possible Points:	**1**			Documentation in progress.
7	**0**	**0**	**9**		**Location and Transportation**		Possible Points:	**16**	**v4.1**		**COMMENTS**
Y	SM	M	N	D/C							
1			**0**	D	Credit 2	Sensitive Land Protection		1			Complies
			2	D	Credit 3	High Priority Site		2			Not applicable
4			**1**	D	Credit 4	Surrounding Density and Diverse Uses		5	v4.1		Site has Walkscore of 65, and qualifies as infill site
0			**5**	D	Credit 5	Access to Quality Transit		5	v4.1		Number of daily bus service trips does not meet minimum threshold
			1	D	Credit 6	Bicycle Facilities		1			Site is not within 200 yds of a bike path that serves 10 diverse uses
1	**0**		**0**	D	Credit 7	Reduced Parking Footprint		1			Provided parking is 80%, meets threshold of 60%
1			**0**	D	Credit 8	Green Vehicles		1	v4.1		Project will provide minimum 2 EV charging stations (or 2% of total) per type of parking
7	**1**	**0**	**2**		**Sustainable Sites**		Possible Points:	**10**	**v4.1**		**COMMENTS**
Y	SM	WM	N	D/C							
Y				C	Prereq 1	Construction Activity Pollution Prevention					Requirement will be in Specifications
	1		**0**	D	Credit 1	Site Assessment		1			In progress; there is no EIS
			2	D	Credit 2	Site Development—Protect or Restore Habitat		2			Not applicable - landscape palette is limited
1		**0**	**0**	D	Credit 3	Open Space		1			Complies
3			**0**	D	Credit 4	Rainwater Management		3	v4.1		Complies; 100% onsite management using LIDs
2			**0**	D	Credit 5	Heat Island Reduction		2			High SRI criteria will be in Specifications
1		**0**	**0**	D	Credit 6	**Light Pollution Reduction (DGS reqt)**		1			Will comply. Light fixtures will meet LZ2 BUG criteria
8	**0**	**0**	**3**		**Water Efficiency**		Possible Points:	**11**	**v4.1**		**COMMENTS**
Y	SM	M	N	D/C							
Y				D	Prereq 1	**Outdoor Water Use Reduction (DGS reqt)**					Will comply; no irrigation
Y				D	Prereq 2	**Indoor Water Use Reduction (DGS reqt)**					Will comply with 20% reduction
Y				D	Prereq 3	Building-Level Water Metering					Will comply and share data via Energy Star Reporting
2			**0**	D	Credit 1	**Outdoor Water Use Reduction (DGS reqt)**		2			Will comply; no irrigation
3			**3**	D	Credit 2	**Indoor Water Use Reduction (DGS reqt)**		6			35.4% - Meets DGS minimum reqt of 35%
2	**0**		**0**	D	Credit 3	Cooling Tower Water Use		2			Registered for Alternate Compliance Path for this Credit WEpc94 - "No cooling tower"
1			**0**	D	Credit 4	Water Metering		1	v4.1		Will comply; meter 2 or more subsystems - irrigation, plumbing, DHW, boiler, reclaimed, other process (meter min 80%)
12	**2**	**5**	**14**		**Energy and Atmosphere**		Possible Points:	**33**	**v4.1**		**COMMENTS**
Y	SM	M	N	D/C							
Y				C	Prereq 1	Fundamental Commissioning and Verification					Will comply. CxA needs to be under contract by 100% DD
Y				D	Prereq 2	**Minimum Energy Performance (DGS reqt)**					Complies. Minimum threshold is 5%, based on ASHRAE 90.1-2010.
Y				D	Prereq 3	Building-Level Energy Metering					Will comply and share data via Energy Star Reporting
Y				D	Prereq 4	Fundamental Refrigerant Management					Complies. Mechanical systems contain no CFCs
6			**0**	C	Credit 1	Enhanced Commissioning		6			Will comply. CxA needs to be under contract by 100% DD
4	**2**	**3**	**9**	D	Credit 2	**Optimize Energy Performance (DGS reqt)**		18			DGS requires 15% better than ASHRAE 90.1-2018. Energy model is in progress due to September decision for full electrification
1			**0**	D	Credit 3	Advanced Energy Metering		1			Will comply. Provide submeters for all whole-bldg energy sources; and any use that is >10% of total
		2	**0**	D	Credit 4	Demand Response		2	v4.1		Awaiting direction from Owner
			3	D	Credit 5	Renewable Energy Production		3			Not applicable
1			**0**	D	Credit 6	Enhanced Refrigerant Management		1			Will comply
		0	**2**	C	Credit 7	Green Power and Carbon Offsets		2			Not applicable

4	2	4	3		**Materials and Resources**		Possible Points:	**13**	**v4.1**	**COMMENTS**
Y	SM	M	N							
Y				D	Prereq 1	Storage and Collection of Recyclables				Will comply; Recycling pickup will be located with trash bins across Rogers Height's Road.
Y					Prereq 1	**Construction and Demolition Waste Management Planning (DGS reqt)**				Performance criteria will be in Specifications
		3	2	C	Credit 1	Building Life Cycle Impact Reduction	5	v4.1		Will pursue only if necessary; calculating embodied Carbon will be a scope add
1		1	0	C	Credit 2	Building Product Disclosure and Optimization - Environmental Product Declaration	2	v4.1		Documentation requirements will be in Specifications
	1		1	C	Credit 3	Building Product Disclosure and Optimization - Sourcing of Raw Materials	2	v4.1		Documentation requirements will be in Specifications
1	1		0	C	Credit 4	Building Product Disclosure and Optimization - Material Ingredients	2	v4.1		Documentation requirements will be in Specifications
2			0	C	Credit 5	**Construction and Demolition Waste Management (DGS reqt)**	2			Documentation requirements will be in Specifications
5	2	4	5		**Indoor Environmental Quality**		Possible Points:	**16**	**v4.1**	**COMMENTS**
Y	SM	M	N							
Y				D	Prereq 1	Minimum Indoor Air Quality Performance				Will comply.
Y				D	Prereq 2	Environmental Tobacco Smoke (ETS) Control				Will comply. Includes DGS tobacco use policy
2			0	D	Credit 1	Enhanced Indoor Air Quality Strategies	2			Will comply; provide entryway systems + dedicated exhaust, filters - 1 pt; CO2 monitoring or inc ventilation - 1 pt (code reqt)
2	1		0	D	Credit 2	**Low-Emitting Materials (DGS reqt)**	3	v4.1		Documentation will be in Specifications; Floors, walls, ceilings and composite wood categories to comply.
1			0	C	Credit 3	**Construction Indoor Air Quality Mangement Plan (DGS reqt)**	1			Documentation requirements will be in Specifications
	0	2	0	C	Credit 4	Indoor Air Quality Assessment	2			DGS reqt for LEED v2009 projects only. Confirm if reqd.
			1	C	Credit 5	Thermal Comfort	1			Unlikely due top cost of providing thermal controls for 50% of occupants
	1	1	0	C	Credit 6	Interior Lighting	2			3-step lighting controls for individual work spaces, dimming for multiple-occupant spaces (1) pt. lighting quality - glare control and coloring rending for +(1) pt
			3	C	Credit 7	Daylight	3	v4.1		Min. 40% of occupied spaces to be compliant: unlikely given number of enclosed offices
			1	C	Credit 8	Quality Views	1	v4.1		Min. 75% of occupied spaces to be compliant: unlikely given number of enclosed offices
		1	0	D	Credit 9	Acoustic Performance	1			TBD
3	2	1	0		**Innovation and Design Process**		Possible Points:	**6**	**v4.1**	**COMMENTS**
Y	SM	M	N							
	1		0	D/C	Credit 1.1	Innovation in Design: O&M starter kit OR Education Outreach	1			DGS to confirm either O+M or Education Outreach
1			0	D/C	Credit 1.2	Innovation in Design: Purchasing lamps	1			ME
	1		0	D/C	Credit 1.3	'Innovation in Design occupant comfort survey	1			FA has survey template. DGS to confirm implementation
1	0		0	D/C	Credit 1.4	Exemplary perf: reduced parking	1			achievable with 80%+ reduction in project
		1	0	D/C	Credit 1.5	Pilot Credit - LEED Safety First Credits	1			DGS to confirm adoption of pandemic-response protocol
1			0	D/C	Credit 2	LEED Accredited Professional	1			Many members of project team are LEED Aps
4	0	0	0		**Regional Priority Credits**		Possible Points:	**4**	**v4.1**	
Y	SM	M	N							
1			0	D/C	Credit 1.1	Reduced Parking Footprint	threshold: 1	1		
1			0	D/C	Credit 1.2	Sensitive Land Protection	threshold: 1	1		
1			0	D/C	Credit 1.3	Rainwater Management	threshold: 3	1		
1			0	D/C	Credit 1.4	Indoor Water Use Reduction	threshold: 3	1		
51	9	14	36		**Total**		Possible Points:	**110**		
60					Certified 40 to 49 points Silver 50 to 59 points Gold 60 to 79 points Platinum 80 to 110					

Legend			
Y	Yes - Project requirement or inherent in nature of the site/location	M	Maybe - more research required
SM	Strong Maybe - likely to be achievable	N	Unachievable / Not Applicable

LEEDv4.1 MATERIALS SUBMITTAL FORM*

Instructions: *Complete this form for all building materials and products provided to the project. Write N/A in any field below that does not apply to that material or product. Attach to this form the supporting documentation that verifies the information provided. This is a LEED v4 project.*

Project: _____

Sub-Contractor: _____Specification Section: _____

Contact name: _____Email: _____ Phone:_____Date:_____

Material / Product name: _____Material / Product cost (excluding labor): _____

Cost is: ☐ Actual ☐ Estimated Is the material structure or enclosure ☐ Yes ☐ No

Environmental Product Declaration (EPD) *EPD attached: ☐ Yes ☐ No*

Is an EPD available for this product / material? ☐ Yes ☐ No (if Yes, continue)

EPD Program Operator: _____

EPD Type: ☐ Product – Specific Type III declaration ☐ Industry-wide generic declaration Type III

☐ Product – Specific, self reported EPD with cradle-to-gate scope

Sourcing of Raw Materials *Supporting documentation attached ☐ Yes ☐ No*

Leadership Extraction Practices (Check the criteria applicable to the product):

☐ Product manufacturer participated in an Extended Producer Responsibility Program

Name of the program_____ % Extender Program Responsibility _____

☐ Product is bio-based and meets Sustainable Agriculture Network (SAN) Std: % bio-based _____

☐ Wood Product is FSC certified: % FSC certified _____FSC Chain of Custody Certificate # _____

☐ Product contains Recycled Content: % preconsumer (by wt) _____% postconsumer (by wt) _____

☐ Product is salvaged, refurbished, or reused: % salvaged, refurbished or reused _____

☐ Entire product sourced regionally (within 100 miles from project site)

Extraction location (city, state) _____miles Manufacture location (city, state) _____miles

Purchase location (city, state) _____ miles

Material Ingredients *Supporting documentation attached: ☐ Yes ☐ No*

Option 1 – Material Ingredient Reporting

Does the product have a chemical ingredients inventory? ☐ Yes ☐ No (if Yes, continue)

*For Projects registered under LEEDv4, opting to comply with v4.1 MR and IEQ Credits

Type of material ingredients reporting:

☐ GreenScreen (GS) ☐ Globally Harmonized System (GHS) ☐ Declare

☐ Health Product Declaration (HPD) ☐ Cradle to Cradle ☐ Product Lens

☐ ANSI/BIFMA e3 Furniture Sustainability Std ☐ Facts – NSF/ ANSI 336

Option 2 – Material Ingredient Optimization

Does the product use materials ingredient optimization using THE following? ☐ Yes ☐ No (if Yes, continue)

☐ GreenScreen v1.2 □ Declare/Living Product Challenge Red List Free ☐ REACH Optimization

☐ Cradle to Cradle v2 Gold or V3 Silver ☐ Cradle to Cradle v2 Platinum or v3 Gold/Platinum

Low-Emitting Materials *Supporting documentation attached: ☐ Yes ☐ No*

Is the material applied on site, within building weather barrier? ☐ Yes ☐ No (if Yes, continue)

Is the product an inherently non-emitting source? ☐ Yes ☐ No (if No, continue)

What category does it belong to?

☐ Interior Paint or Coating ☐ Interior Adhesive & Sealants ☐ Composite Wood

☐ Flooring ☐ Furniture ☐ Ceilings, Wall, or Insulation

VOC Emission requirements:

Product meets California Department of Public Health (CDPH) Std Method v1.1 -2010: □ Yes □ No

Does the product have following emissions certifications:

☐ Berkeley Analytical ClearChem ☐ CDPH High Performance Product ☐ MAS Certified Green

☐ Intertek ETL Environmental VOC/VOC + ☐ UL Greenguard GOLD ☐ SCS Indoor Advantage GOLD

☐ RFCI FloorScore ☐ CRI Geen Label Plus ☐ Self-reported

Range of TVOCs after 14 days: ☐ 0.5 mg/m3 or less ☐ between 0.5 and 5.0 mg/m3 ☐ 5.0 mg/m3 or more

VOC Content requirements:

Does the product meet applicable regulation:

☐ SCAQMD Rule 1113 (Interior paint and coating) ☐ SCAQMD Rule 1168 (Interior Adhesive/Sealants)

☐ CARB ULEF or NAUF (Composite wood) ☐ ANSI/ BIFMA Std Method M7.1-2010 (Furniture)

Product type_____ Allowable VOC Content (g/L) _____VOC Content (g/L)_____

Total Volume Purchased (L)_____

Contain Lead ☐ Yes ☐ No Contains intentionally added Cadmium ☐ Yes ☐ No

Does submitted material contain lead? ☐ Yes ☐ No

Does submitted material contain PVC? ☐ Yes ☐ No

Does submitted material contain tropical hardwood or virgin hardwood? ☐ Yes ☐ No

*For Projects registered under LEEDv4, opting to comply with v4.1 MR and IEQ Credits

SECTION 02 41 19 - SELECTIVE DEMOLITION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Contractor's use of site and premises.
2. Coordination with occupants.
3. Work restrictions.
4. Demolition and removal of selected portions of building or structure.
5. Salvage of existing items to be reused or recycled.

B. Related Requirements:

1. Section 01 73 00 "Execution" for cutting and patching procedures.
2. Section 06 01 40.99 "Relocation, Reuse, and Restoration of Historic Courtroom Woodwork" for reuse of historic woodwork from existing courthouse to new courthouse.
3. Section 09 27 13 “Glass-Fiber-Reinforced Gypsum Fabrications” for requirement of GFRG fabrications created from molds of existing historic ceiling configuration and ornamentation.

1.2 DEFINITIONS

A. Remove: Detach items from existing construction and dispose of them off-site unless indicated to be salvaged or reinstalled.

B. Remove and Salvage: Detach items from existing construction, in a manner to prevent damage, and store.

C. Remove and Reinstall: Detach items from existing construction, in a manner to prevent damage, prepare for reuse, and reinstall where indicated.

D. Existing to Remain: Leave existing items that are not to be removed and that are not otherwise indicated to be salvaged or reinstalled.

E. Dismantle: To remove by disassembling or detaching an item from a surface, using gentle methods and equipment to prevent damage to the item and surfaces; disposing of items unless indicated to be salvaged or reinstalled.

1.3 MATERIALS OWNERSHIP

A. Unless otherwise indicated, demolition waste becomes property of Contractor.

B. Historic items, relics, antiques, and similar objects including, but not limited to, all historic courtroom finishes, and other items of interest or value to Owner that may be uncovered during demolition remain the property of Owner.

1. Carefully salvage in a manner to prevent damage and promptly return to Owner, except store, refurbish, and reinstall millwork in new courthouse as indicated on Drawings and specified in Section 06 01 40.99 “"Relocation, Reuse, and Restoration of Historic Courtroom Woodwork.”

1.4 PREINSTALLATION MEETINGS

A. Pre-demolition Conference: Conduct conference at Project site.

1. Review requirements related to Contractor’s use of site and premises, coordination with occupants, and work restrictions.
2. Inspect and discuss condition of construction to be selectively demolished.
3. Review and finalize selective demolition schedule and verify availability of materials, demolition personnel, equipment, and facilities needed to make progress and avoid delays.
4. Review areas where existing construction is to remain and requires protection.

1.5 INFORMATIONAL SUBMITTALS

A. Proposed Protection Measures: Submit report, including Drawings, that indicates the measures proposed for protecting individuals and property, for dust control and for noise control. Indicate proposed locations and construction of barriers.

B. Schedule of Selective Demolition Activities: Indicate the following:

1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity. Ensure Owner's building manager's and other tenants' on-site operations are uninterrupted.
2. Interruption of utility services, if required. Indicate how long utility services will be interrupted.
3. Coordination for shutoff, capping, and continuation of utility services, if required.
4. Use of elevator and stairs.
5. Coordination of Owner's continuing occupancy of portions of existing building and of Owner's partial occupancy of completed Work.

C. Pre-demolition Photographs or Video: Show existing conditions of adjoining construction, including finish surfaces, that might be misconstrued as damage caused by salvage and demolition operations. Comply with Section 01 32 33 "Photographic Documentation." Submit before Work begins.

1.6 CLOSEOUT SUBMITTALS

A. Inventory: Submit a list of items that have been removed and salvaged.

1.7 FIELD CONDITIONS

A. Owner will occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted.

B. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.

C. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.

1. If suspected hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Hazardous materials will be removed by Owner under a separate contract.

D. Historic Areas: Demolition and hauling equipment and other materials shall be of sizes that clear surfaces within historic spaces, areas, rooms, and openings, including temporary protection, by 12 inches or more.

E. Storage or sale of removed items or materials on-site is not permitted.

F. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.

1. Maintain fire-protection facilities in service during selective demolition operations.

1.8 CONTRACTOR'S USE OF SITE AND PREMISES

A. Limits on Use of Site: Limit use of Project site to Work in areas indicated. Do not disturb portions of Project site beyond areas in which the Work is indicated.

B. Condition of Existing Building: Maintain portions of existing building affected by construction operations in a weathertight condition throughout construction period. Repair damage caused by construction operations.

1.9 COORDINATION WITH OCCUPANTS

A. Full Owner Occupancy: Owner will occupy Project site and existing building during entire construction period. Cooperate with Owner during construction operations to minimize conflicts and facilitate Owner usage. Perform the Work so as not to interfere with Owner's day-to-day operations. Maintain existing exits unless otherwise indicated.

1. Maintain access to existing walkways, corridors, and other adjacent occupied or used facilities. Do not close or obstruct walkways, corridors, or other occupied or used facilities without written permission from Owner and approval of authorities having jurisdiction.
2. Notify Owner not less than 72 hours in advance of activities that will affect Owner's operations.

1.10 WORK RESTRICTIONS

A. Comply with restrictions on construction operations.

1. Comply with limitations on use of public streets, work on public streets, rights of way, and other requirements of authorities having jurisdiction.

B. On-Site Work Hours: Limit work to between 9:00 a.m. to 5:00 p.m., Monday through Friday, unless otherwise indicated. Work hours may be modified to meet Project requirements if approved by Owner and authorities having jurisdiction.

1. Weekend Hours: Not permitted unless approved in writing by Owner.
2. Early Morning Hours: Not permitted unless approved in writing by Owner.
3. Hours for Utility Shutdowns: Only at times approved in writing by Owner.
4. Hours for noisy activity: Only at times approved in writing by Owner.

C. Existing Utility Interruptions: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging for temporary utility services according to requirements indicated:

1. Notify Owner not less than five days in advance of proposed utility interruptions.
2. Obtain Owner's written permission before proceeding with utility interruptions.

D. Noise, Vibration, Dust, and Odors: Coordinate operations that may result in high levels of noise and vibration, dust, odors, or other disruption to Owner occupancy with Owner.

1. Notify Owner not less than five (5) days in advance of proposed disruptive operations.
2. Obtain Owner's written permission before proceeding with disruptive operations.

E. Smoking and Controlled Substance Restrictions: Use of tobacco products, alcoholic beverages, and other controlled substances within the existing building is not permitted.

F. Employee Identification: Owner will provide identification tags for Contractor personnel working on Project site. Require personnel to use identification tags at all times.

G. Employee Screening: Comply with Owner's requirements for drug and background screening of Contractor personnel working on Project site.

1. Maintain list of approved screened personnel with Owner's representative.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.

B. Standards: Comply with ANSI/ASSP A10.6 and NFPA 241.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Survey of Existing Conditions: Record existing conditions by use of preconstruction photographs or video.

1. Inventory and record the condition of items to be removed and salvaged.
2. Before selective demolition or removal of existing building elements that will be reproduced or duplicated in final Work, make permanent record of measurements, materials, and construction details required to make exact reproduction.

3.2 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

A. Existing Services/Systems to Remain: Maintain services/systems to remain and protect them against damage.

B. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off utility services and mechanical/electrical systems serving areas to be selectively demolished.

1. Owner will arrange to shut off indicated services/systems when requested by Contractor.
2. If services/systems are required to be removed, relocated, or abandoned, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.

3.3 PROTECTION

A. Temporary Protection: Provide temporary barricades and other protection required to prevent injury to people and damage to facilities to remain.

1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.
2. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.

B. Remove temporary barricades and protections where hazards no longer exist.

3.4 SELECTIVE DEMOLITION, GENERAL

A. General: Demolish and remove existing construction only to the extent required and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:

1. Proceed with selective demolition systematically.
2. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping. Temporarily cover openings to remain.

3. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
4. Do not use cutting torches. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting cutting operations. Maintain portable fire-suppression devices during cutting operations.
5. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
6. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
7. Dispose of demolished items and materials promptly. Comply with requirements in Section 01 74 19 "Construction Waste Management and Disposal."

B. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

C. Work in Historic Areas: In historic spaces, areas, and rooms, or on historic surfaces, the terms "demolish" or "remove" shall mean historic "removal" or "dismantling" and protected for reuse in new courthouse.

D. Removed and Salvaged Items:

1. Clean salvaged items.
2. Pack or crate items after cleaning. Identify contents of containers.
3. Store items in a secure area.
4. Protect items from damage during transport and storage.

E. Removed and Reinstalled Items:

1. Clean and repair items to functional condition adequate for intended reuse.
2. Pack or crate items after cleaning and repairing. Identify contents of containers.
3. Protect items from damage during transport and storage.
4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.

3.5 DISPOSAL OF DEMOLISHED MATERIALS

A. Remove demolition waste materials from Project site and recycle or dispose of them according to Section 01 74 19 "Construction Waste Management and Disposal."

1. Do not allow demolished materials to accumulate on-site.
2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
3. Remove debris from elevated portions of building in a controlled manner and by means that will not impede use of the adjacent occupied areas of the building.
4. Comply with requirements specified in Section 01 74 19 "Construction Waste Management and Disposal."

B. Burning: Do not burn demolished materials.

3.6 CLEANING

A. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

END OF SECTION

This page is intentionally left blank.

SECTION 03 10 00 - CONCRETE FORMING AND ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Form-facing material for cast-in-place concrete.
2. Form liners.
3. Waterstops.
4. Embedded items.
5. Shoring, bracing, and anchoring.

1.2 DEFINITIONS

A. Form-Facing Material: Temporary structure or mold for the support of concrete while the concrete is setting and gaining sufficient strength to be self-supporting.

B. Formwork: The total system of support of freshly placed concrete, including the mold or sheathing that contacts the concrete, as well as supporting members, hardware, and necessary bracing.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review the following:

a. Special inspection and testing and inspecting agency procedures for field quality control.
b. Construction, movement, contraction, and isolation joints
c. Forms and form-removal limitations.
d. Anchor rod and anchorage device installation tolerances.

1.4 ACTION SUBMITTALS

A. Product Data: For each of the following:

1. Exposed surface form-facing material.
2. Concealed surface form-facing material.
3. Forms for cylindrical columns.
4. Pan-type forms.
5. Void forms.
6. Form liners.
7. Insulating concrete forms.
8. Form ties.

9. Waterstops.
10. Dovetail anchors.
11. Form-release agent.

B. Sustainable Design Submittals:

1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.
2. Laboratory Test Reports: For liquid floor treatments and curing and sealing compounds, indicating compliance with requirements for low-emitting materials.

C. Shop Drawings: Formwork plans prepared by, and signed and sealed by, a qualified professional engineer registered in the state of the project and responsible for their preparation, detailing fabrication, assembly, and support of forms.

1. For exposed vertical concrete walls, indicate dimensions and form tie locations.
2. Indicate dimension and locations of construction and movement joints required to construct the structure in accordance with ACI 301.

    a. Location of construction joints is subject to approval of the Architect.

3. Indicate location of waterstops.
4. Indicate applicable dead, live, and other loads for which the formwork has been designed.
5. Indicate form liner layout and form line termination details.
6. Indicate proposed schedule and sequence of stripping of forms, shoring removal, and reshoring installation and removal.
7. Indicate layout of insulating concrete forms, dimensions, course heights, form types, and details.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing and inspection agency.

B. Research Reports: For insulating concrete forms indicating compliance with International Code Council Acceptance Criteria AC353.

C. Field quality-control reports.

D. Minutes of preinstallation conference.

1.6 QUALITY ASSURANCE

A. Testing and Inspection Agency Qualifications: An independent agency, acceptable to authorities having jurisdiction, qualified in accordance with ASTM C1077 and ASTM E329 for testing indicated.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Form Liners: Store form liners under cover to protect from sunlight.

B. Insulating Concrete Forms: Store forms off ground and under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.

C. Waterstops: Store waterstops under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Concrete Formwork: Design, engineer, erect, shore, brace, and maintain formwork, shores, and reshores in accordance with ACI 301 (ACI 301M), to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads, so that resulting concrete conforms to the required shapes, lines, and dimensions.

1. Design wood panel forms in accordance with APA's "Concrete Forming Design/Construction Guide."
2. Design formwork to limit deflection of form-facing material to 1/240 of center-to-center spacing of supports.

    a. For architectural concrete specified in Section 03 45 00 "Precast Architectural Concrete," limit deflection of form-facing material, studs, and walers to 0.0025 times their respective clear spans (L/400).

2.2 FORM-FACING MATERIALS

A. As-Cast Surface Form-Facing Material:

1. Provide continuous, true, and smooth concrete surfaces.
2. Furnish in largest practicable sizes to minimize number of joints.
3. Acceptable Materials: As required to comply with Surface Finish designations specified in Section 03 30 00 "Cast-In-Place Concrete, and as follows:

    a. Plywood, metal, or other approved panel materials.
    b. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and as follows:

        1) APA HDO (high-density overlay).
        2) APA MDO (medium-density overlay); mill-release agent treated and edge sealed.

B. Concealed Surface Form-Facing Material: Lumber, plywood, metal, plastic, or another approved material.

1. Provide lumber dressed on at least two edges and one side for tight fit.

C. Pan-Type Forms: Glass-fiber-reinforced plastic or formed steel, stiffened to resist plastic concrete loads without detrimental deformation, with straight or tapered end forms.

2.3 WATERSTOPS

A. Self-Expanding Rubber Strip Waterstops: Manufactured rectangular or trapezoidal strip, bentonite-free hydrophilic polymer-modified chloroprene rubber, for adhesive bonding to concrete.

1. Basis-of-Design Product: Subject to compliance with requirements, provide GCP Applied Technologies Inc.; ADCOR ES or a comparable product by one of the following:

a. CETCO is a subsidiary of Minerals Technologies Inc.
b. Sika Corporation.

2.4 RELATED MATERIALS

A. Reglets: Fabricate reglets of not less than 0.022-inch- thick, galvanized-steel sheet. Temporarily fill or cover face opening of reglet to prevent intrusion of concrete or debris.

B. Dovetail Anchor Slots: Hot-dip galvanized-steel sheet, not less than 0.034 inch thick, with bent tab anchors. Temporarily fill or cover face opening of slots to prevent intrusion of concrete or debris.

C. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch, minimum.

D. Rustication Strips: Wood, metal, PVC, or rubber strips, kerfed for ease of form removal.

E. Form-Release Agent: Commercially formulated form-release agent that does not bond with, stain, or adversely affect concrete surfaces and does not impair subsequent treatments of concrete surfaces.

1. Formulate form-release agent with rust inhibitor for steel form-facing materials.
2. Form release agent for form liners shall be acceptable to form liner manufacturer.

F. Form Ties: Factory-fabricated, removable or snap-off, glass-fiber-reinforced plastic or metal form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.

1. Furnish units that leave no corrodible metal closer than 1 inch to the plane of exposed concrete surface.
2. Furnish ties that, when removed, leave holes no larger than 1 inch in diameter in concrete surface.
3. Furnish ties with integral water-barrier plates to walls indicated to receive dampproofing or waterproofing.

PART 3 - EXECUTION

3.1 INSTALLATION OF FORMWORK

A. Design, erect, shore, brace and maintain formwork according to ACI 301 (ACI 301M) to support vertical, lateral, static and dynamic loads, and construction loads, until structure can support such loads.

B. Construct formwork, so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117 (ACI 117M) and to comply with the Surface Finish designations specified in Section 03 30 00 "Cast-In-Place Concrete" for as-cast finishes.

C. Limit concrete surface irregularities as follows:

1. Surface Finish-1.0: ACI 117 Class D, 1 inch.
2. Surface Finish-2.0: ACI 117 Class B, 1/4 inch.
3. Surface Finish-3.0: ACI 117 Class A, 1/8 inch.

D. Construct forms tight enough to prevent loss of concrete mortar.

1. Minimize joints.
2. Exposed Concrete: Symmetrically align joints in forms.

E. Construct removable forms for easy removal without hammering or prying against concrete surfaces.

1. Provide crush or wrecking plates where stripping may damage cast-concrete surfaces.
2. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.
3. Install keyways, reglets, recesses, and other accessories, for easy removal.

F. Do not use rust-stained, steel, form-facing material.

G. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces.

1. Provide and secure units to support screed strips
2. Use strike-off templates or compacting-type screeds.

H. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible.

1. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar.
2. Locate temporary openings in forms at inconspicuous locations.

I. Chamfer exterior corners and edges of permanently exposed concrete.

J. At construction joints, overlap forms onto previously placed concrete not less than 12 inches.

K. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work.

1. Determine sizes and locations from trades providing such items.
2. Obtain written approval of Architect prior to forming openings not indicated on Drawings.

L. Construction and Movement Joints:

1. Construct joints true to line with faces perpendicular to surface plane of concrete.
2. Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.

3. Place joints perpendicular to main reinforcement.
4. Locate joints for beams, slabs, joists, and girders in the middle third of spans.

    a. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.

5. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
6. Space vertical joints in walls as indicated on Drawings.

    a. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.

M. Provide temporary ports or openings in formwork where required to facilitate cleaning and inspection.

1. Locate ports and openings in bottom of vertical forms, in inconspicuous location, to allow flushing water to drain.
2. Close temporary ports and openings with tight-fitting panels, flush with inside face of form, and neatly fitted, so joints will not be apparent in exposed concrete surfaces.

N. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.

O. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.

P. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.2 INSTALLATION OF EMBEDDED ITEMS

A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. All embedded items shall be installed perpendicular to substrate surface unless otherwise indicated.

1. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
2. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC 303.
3. Install reglets to receive waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.
4. Install dovetail anchor slots in concrete structures, as indicated on Drawings.
5. Clean embedded items immediately prior to concrete placement.
6. Post installed mechanical and adhesive anchors shall be installed per Manufacturer’s Printed Installation Instructions (MPII), and in accordance with Section 05 05 19 “Post Installed Anchors”.

3.3 INSTALLATION OF WATERSTOPS

A. Self-Expanding Strip Waterstops: Install in construction joints and at other locations indicated on Drawings, according to manufacturer's written instructions, by adhesive bonding, mechanically fastening, and firmly pressing into place.

1. Install in longest lengths practicable.
2. Locate waterstops in center of joint unless otherwise indicated on Drawings.
3. Protect exposed waterstops during progress of the Work.

3.4 REMOVING AND REUSING FORMS

A. Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F (10 deg C) for 24 hours after placing concrete. Concrete has to be hard enough to not be damaged by form-removal operations, and curing and protection operations need to be maintained.

1. Leave formwork for beam soffits, joists, slabs, and other structural elements that support weight of concrete in place until concrete has achieved at least 70 percent of its 28-day design compressive strength.
2. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.

B. Clean and repair surfaces of forms to be reused in the Work.

1. Split, frayed, delaminated, or otherwise damaged form-facing material are unacceptable for exposed surfaces.
2. Apply new form-release agent.

C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints.

1. Align and secure joints to avoid offsets.
2. Do not use patched forms for exposed concrete surfaces unless approved by Architect.

3.5 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a special inspector and qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Inspections:

1. Inspect formwork for shape, location, and dimensions of the concrete member being formed.

END OF SECTION

This page is intentionally left blank.

SECTION 03 30 00 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Cast-in-place concrete, including reinforcement, concrete materials, mixture design, placement procedures, and finishes.

B. Related Requirements:

1. Section 31 20 00 "Earth Moving" for drainage fill under slabs-on-ground.
2. Section 32 13 13 "Concrete Paving" for concrete pavement and walks.
3. Section 32 13 16 "Decorative Concrete Paving" for decorative concrete pavement and walks.
4. Section 03 10 00 "Concrete Forming and Accessories" for formwork and embedded items.
5. Section 05 05 19 "Post Installed Anchors" for post-installed anchors into concrete.
6. Section 05 12 00 "Structural Steel Framing" for non-shrink grout.

1.2 DEFINITIONS

A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash, slag cement, other pozzolans, and silica fume; materials subject to compliance with requirements.

B. Water/Cement Ratio (w/cm): The ratio by weight of water to cementitious materials.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:

a. Contractor's superintendent.
b. Independent testing agency responsible for concrete design mixtures.
c. Ready-mix concrete manufacturer.
d. Concrete Subcontractor.

2. Review the following:

a. Special inspection and testing and inspecting agency procedures for field quality control.
b. Construction joints, control joints, isolation joints, and joint-filler strips.

c. Semirigid joint fillers.
d. Vapor-retarder installation.
e. Anchor rod and anchorage device installation tolerances.
f. Steel reinforcement installation.
g. Cold and hot weather concreting procedures.
h. Integral concrete color
i. Concrete finishes and finishing.
j. Curing procedures.
k. Forms and form-removal limitations.
l. Shoring and reshoring procedures.
m. Methods for achieving specified floor and slab flatness and levelness.
n. Floor and slab flatness and levelness measurements.
o. Concrete repair procedures.
p. Concrete protection.
q. Initial curing and field curing of field test cylinders (ASTM C31.)
r. Protection of field cured field test cylinders.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:

1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.
2. Laboratory Test Reports: For liquid floor treatments and curing and sealing compounds, indicating compliance with requirements for low-emitting materials.

C. Design Mixtures: For each concrete mixture, include the following:

1. Mixture identification, clearly indicating where mix is to be used on the Project.
2. Minimum 28-day compressive strength.
3. Durability exposure class.
4. Maximum w/cm.
5. Calculated equilibrium unit weight, for lightweight concrete.
6. Slump limit.
7. Air content.
8. Nominal maximum aggregate size.
9. Preconstruction test reports, for each mix design.
10. Indicate amounts of mixing water to be withheld for later addition at Project site if permitted.
11. Include certification from the admixture manufacturer that chloride content complies with specified requirements and ASTM C1582.
12. Include certification from the admixture manufacturer that all admixtures are compatible with other required or proposed admixtures.
13. Intended placement method.
14. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
15. Integral concrete color

D. Shop Drawings:

1. Steel Reinforcement Layout:

    a. Comply with ACI SP-066.
    b. Detail fabrication, bending and placement. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and lap lengths, details of mechanical splice connectors, details of welding splices, tie and hoop spacing, and supports for concrete reinforcement.

2. Sleeve Locations: Submit plan showing dimensioned locations and sizes of sleeves and openings for review by Architect and Engineer, prior to concrete placement.
3. Construction Joint Layout: Indicate dimensioned locations of proposed construction joints for concrete slabs and walls required to construct the structure.

    a. Location of construction joints is subject to approval of the Architect.

4. Contraction (Crack Control) Joint Layout in Slabs on Grade: Indicate dimensioned location of proposed construction and control joints. Include proposed time frame for installation of control joints if by sawcutting methods as specified.

    a. Location of construction and control joints is subject to approval of the Architect.

E. Concrete Schedule: For each location of each type of concrete indicated in "Concrete Mixtures for Building Elements" Article, including the following:

1. Concrete type designation.
2. Location within Project.
3. Exposure Class designation.
4. Formed Surface Finish designation and final finish.
5. Final finish for floors.
6. Curing process.
7. Floor treatment if any.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For the following:

1. Installer: Include copies of applicable ACI certificates.
2. Ready-mixed concrete manufacturer.
3. Testing agency: Include copies of applicable ACI certificates.

B. Welding Certificates.

1. Reinforcement to be welded: Welding procedure specification in accordance with AWS D1.4/D1.4M.

C. Material Certificates: For each of the following, signed by manufacturers certifying that each material item complies with or exceeds the specified requirements:

1. Cementitious materials.
2. Admixtures.
3. Integral Concrete Color.
4. Steel reinforcement and accessories.

5. Fiber reinforcement.
6. Curing compounds.
7. Floor and slab treatments.
8. Bonding agents.
9. Adhesives.
10. Vapor retarders.
11. Semirigid joint filler.
12. Joint-filler strips.
13. Repair materials.

D. Material Test Reports: For the following, from a qualified testing agency:

1. Portland cement.
2. Fly ash.
3. Slag cement.
4. Blended hydraulic cement.
5. Silica fume.
6. Performance-based hydraulic cement.
7. Aggregates:

    a. Include service record data indicating absence of deleterious expansion of concrete due to alkali reactivity.

8. Admixtures:

    a. Permeability-Reducing Admixture: Include independent test reports, indicating compliance with specified requirements, including dosage rate used in test.

9. Steel Reinforcement:

    a. For reinforcement to be welded, mill test analysis for chemical composition and carbon equivalent of the steel in accordance with ASTM A706/A706M.

10. Mechanical Splice Couplers.

E. Floor surface flatness and levelness measurements report, indicating compliance with specified tolerances.

F. Research Reports:

1. For concrete admixtures in accordance with ICC's Acceptance Criteria AC198.

G. Field quality-control reports.

H. Minutes of preinstallation conference.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer who employs Project personnel qualified as an ACI-certified Flatwork Technician and Finisher and a supervisor who is a certified ACI Flatwork Concrete Finisher/Technician or an ACI Concrete Flatwork Technician with experience installing and finishing concrete, incorporating permeability-reducing admixtures.

B. Ready-Mixed Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C94 requirements for production facilities and equipment.

1. Manufacturer certified in accordance with NRMCA's "Certification of Ready Mixed Concrete Production Facilities."

C. Laboratory Testing Agency Qualifications: A testing agency qualified in accordance with ASTM C1077 and ASTM E329 for testing indicated and employing an ACI-certified Concrete Quality Control Technical Manager.

1. Personnel performing laboratory tests shall be an ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician, Grade I. Testing agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician, Grade II.

D. Field Quality Control Testing Agency Qualifications: An independent agency, acceptable to authorities having jurisdiction, qualified in accordance with ASTM C1077 and ASTM E329 for testing indicated.

1. Personnel conducting field tests shall be qualified as an ACI Concrete Field Testing Technician, Grade 1, in accordance with ACI CPP 610.1 or an equivalent certification program.

E. Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.4/D 1.4M.

F. Mockups: Cast concrete formed-surface panels to demonstrate color, typical joints, surface finish, texture, tolerances and standard of workmanship.

1. Build one wall section panel minimum 100 SF in the location selected by the Landscape Architect.
2. Show expansion joint and smooth rubbed finish.
3. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 PRECONSTRUCTION TESTING

A. Preconstruction Testing Service: Engage a qualified testing agency to perform preconstruction testing on each concrete mixture.

1. Include the following information in each test report:

a. Admixture dosage rates.
b. Slump.
c. Air content.
d. Seven-day compressive strength.
e. 28-day compressive strength.
f. Permeability.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Comply with ASTM C94 and ACI 301.

B. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage.

1. Store reinforcement to avoid contact with earth.
2. Do not allow epoxy-coated reinforcement to be stored outdoors for more than 60 days without being stored under an opaque covering.
3. Do not allow dual-coated reinforcement to be stored outdoors for more than 60 days without being stored under an opaque covering.
4. Do not allow stainless steel reinforcement to come into contact with uncoated reinforcement.

1.9 FIELD CONDITIONS

A. Cold-Weather Placement: Comply with ACI 301 and ACI 306.1 and as follows.

1. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
2. When average high and low temperature is expected to fall below 40 deg F for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
3. Do not use frozen materials or materials containing ice or snow.
4. Do not place concrete in contact with surfaces less than 35 deg F, other than reinforcing steel.
5. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.

B. Hot-Weather Placement: Comply with ACI 301 and ACI 305.1, and as follows:

1. Maintain concrete temperature at time of discharge to not exceed 95 deg F.
2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

PART 2 - PRODUCTS

2.1 CONCRETE, GENERAL

A. ACI Publications: Comply with ACI 301 and ACI 117 unless modified by requirements in the Contract Documents.

2.2 STEEL REINFORCEMENT

A. Recycled Content of Steel Products: Provide products with postconsumer recycled content plus one-half of preconsumer recycled content to the extent required to comply with the minimum criteria specified in Section 01 81 13.14 “Sustainable Design Requirements.”

B. Reinforcing Bars: ASTM A615/A615M, Grade 60 (Grade 420), deformed.

C. Low-Alloy Steel Reinforcing Bars: ASTM A706/A706M, deformed.

D. Headed-Steel Reinforcing Bars: ASTM A970/A970M.

E. Steel Bar Mats: ASTM A184/A184M, fabricated from ASTM A615/A615M, Grade 60 (Grade 420), deformed bars, assembled with clips.

F. Plain-Steel Welded-Wire Reinforcement: ASTM A1064/A1064M, plain, fabricated from as-drawn steel wire into flat sheets.

G. Deformed-Steel Welded-Wire Reinforcement: ASTM A1064/A1064M, flat sheet.

2.3 REINFORCEMENT ACCESSORIES

A. Joint Dowel Bars: ASTM A615, Grade 60, plain-steel bars, cut true to length with ends square and free of burrs.

B. Epoxy-Coated Joint Dowel Bars: ASTM A615, Grade 60, plain-steel bars, ASTM A775 epoxy coated.

C. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded-wire reinforcement in place.

1. Manufacture bar supports from steel wire, plastic, or precast concrete in accordance with CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:

a. For concrete surfaces exposed to view, where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire, all-plastic bar supports, or CRSI Class 2 stainless steel bar supports.

D. Mechanical Splice Couplers: ACI 318 Type 2, same material of reinforcing bar being spliced; dowel-bar type.

E. Steel Tie Wire: ASTM A1064, annealed steel, not less than 0.0508 inch in diameter.

1. Finish: Galvanized.

F. Stainless Steel Tie Wire: ASTM A1022, not less than 0.0508 inch in diameter.

G. Epoxy Repair Coating: Liquid, two-part, epoxy repair coating; compatible with epoxy coating on reinforcement and complying with ASTM A775.

H. Zinc Repair Material: ASTM A780.

2.4 FABRICATING REINFORCEMENT

A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

2.5 CONCRETE MATERIALS

A. Regional Materials: Verify concrete is manufactured within 100 miles of Project site from aggregates that have been extracted, harvested, or recovered, as well as manufactured, within 100 miles of Project site.

B. Source Limitations:

1. Obtain all concrete mixtures from a single ready-mixed concrete manufacturer for entire Project.
2. Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant.
3. Obtain aggregate from single source.

C. Admixture Limitations:

1. Admixtures shall conform to ASTM C1582 for inhibiting chloride-induced corrosion.
2. Calcium chloride or admixtures that contribute water-soluble chloride ions exceeding those permitted in hardened concrete shall not be used.
3. Specific admixtures, including admixtures listed within this section, are acceptable only if manufacturer can submit evidence of product compatibility with other products within the same concrete mix.

D. Cementitious Materials:

1. Portland Cement: ASTM C150, Type I/II, gray, except as follows:
   a. Site Wall 1 Portland Cement: ASTM C150, Type I/II, white.
2. Fly Ash: ASTM C618, Class C or F.
3. Slag Cement: ASTM C989, Grade 100 or 120.
4. Blended Hydraulic Cement: ASTM C595, Type IS, portland blast-furnace slag; Type IP, portland-pozzolan; Type IL, portland-limestone; Type IT, ternary blended.
5. Silica Fume: ASTM C1240 amorphous silica.
6. Performance-Based Hydraulic Cement: ASTM C1157: Type GU, general use; or Type HE, high early strength, if required by Contractor.

E. Normal-Weight Aggregates: ASTM C33, Class 3S coarse aggregate or better, graded. Provide aggregates from a single source.

1. Alkali-Silica Reaction: Comply with one of the following:

   a. Expansion Result of Aggregate: Not more than 0.04 percent at one-year when tested in accordance with ASTM C1293.
   b. Expansion Results of Aggregate and Cementitious Materials in Combination: Not more than 0.10 percent at an age of 16 days when tested in accordance with ASTM C1567.
   c. Alkali Content in Concrete: Not more than 4 lb./cu. yd. for moderately reactive aggregate or 3 lb./cu. yd. for highly reactive aggregate, when tested in accordance with ASTM C1293 and categorized in accordance with ASTM C1778, based on alkali content being calculated in accordance with ACI 301.

2. Maximum Coarse-Aggregate Size: See “Concrete Mixtures for Building Elements”.
3. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

F. Lightweight Aggregate: ASTM C330. See “Concrete Mixtures for Building Elements” for nominal maximum aggregate size. Aggregates shall be suitably processed, washed and screened, and shall consist of durable particles without adherent coatings.

G. Air-Entraining Admixture: ASTM C260.

H. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures that do not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.

1. Water-Reducing Admixture: ASTM C494, Type A.
2. Retarding Admixture: ASTM C49, Type B.
3. Water-Reducing and -Retarding Admixture: ASTM C494, Type D.
4. High-Range, Water-Reducing Admixture: ASTM C494, Type F.
5. High-Range, Water-Reducing and -Retarding Admixture: ASTM C494, Type G.
6. Plasticizing and Retarding Admixture: ASTM C1017, Type II.

I. Color Pigment for Site Wall 1 – Cheek Wall: ASTM C 979, synthetic mineral-oxide pigments or colored water-reducing admixtures; color stable, nonfading, and resistant to lime and other alkalis.
1. Manufacturers: Subject to compliance with requirement
Scofield, L. M. Company
Telephone: 800-800-990
Website: www.scofield.com

a. Or approved equal.

2. Colors: Mesa Beige C-12, Chromix.
3. Finish: Rubbed.

J. Water and Water Used to Make Ice: ASTM C94.

1. Free of foreign matter that may be harmful to concrete, reinforcement, or concrete accessories, including but not limited to oils, acids, alkalies, salts, and organic materials.
2. Free of deleterious amounts of chloride ions.

2.6 VAPOR RETARDERS

A. Sheet Vapor Retarder, Class A: ASTM E1745, Class A, except with maximum water-vapor permeance of 0.01; not less than 15 mils thick. Include manufacturer's recommended adhesive or pressure-sensitive tape.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Raven Industries, Inc; Vapor Block VB15, Class A.
b. Reef Industries, Inc.; Griffolyn, 15 mil Green.
c. Stego Industries, LLC; Stego Wrap Vapor Barrier (15-Mil).
d. W. R. Meadows, Inc; Perminator 15 mil.

2.7 LIQUID FLOOR TREATMENTS

A. Penetrating Liquid Floor Treatment: Clear, chemically reactive, waterborne solution of inorganic silicate or siliconate materials and proprietary components; odorless; that penetrates, hardens, and densifies concrete surfaces.

B. Penetrating Liquid Floor Treatment: Clear, chemically reactive, waterborne solution of inorganic silicate or siliconate materials and proprietary components; odorless; that penetrates, hardens, and densifies concrete surfaces.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Dayton Superior Corporation; Densifier J13.
b. Euclid Chemical Company (The); an RPM company; Euco Diamond Hard.
c. Laticrete International, Inc.; Seal Hard.
d. W. R. Meadows, Inc; Liqui-Hard.

2. Verify products comply with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

2.8 CURING MATERIALS

A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.

1. Products: Subject to compliance with requirements, provide one of the following or approved equal:

a. BASF Corporation; MasterKure ER 50.
b. ChemMasters, Inc; Spray-Film.
c. Dayton Superior; AquaFilm Concentrate J74.
d. Euclid Chemical Company (The); an RPM company; Eucobar.
e. Kaufman Products, Inc; VaporAid.
f. Sika Corporation; SikaFilm.
g. SpecChem, LLC; Spec Film.
h. W.R. Meadows, Inc; EVAPRE.

B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.

C. Moisture-Retaining Cover: ASTM C171, polyethylene film burlap-polyethylene sheet.

1. Color:

a. Ambient Temperature Below 50 deg F: Black.
b. Ambient Temperature between 50 deg F and 85 deg F: Any color.
c. Ambient Temperature Above 85 deg F: White.

D. Water: Potable or complying with ASTM C1602.

E. Clear, Waterborne, Membrane-Forming, Dissipating Curing Compound: ASTM C309, Type 1, Class B.

1. Products: Subject to compliance with requirements, provide one of the following or approved equal:

a. BASF Corporation; MasterKure CC 160 WB.
b. ChemMasters, Inc; Safe-Cure Clear DR.
c. Euclid Chemical Company (The); an RPM company; Kurez DR VOX.
d. Kaufman Products, Inc; ThinFilm 420.
e. SpecChem, LLC; SpecRez.
f. TK Products; DC WB Dissipating Cure 2519.
g. Vexcon Chemicals Inc.; Certi-Vex Envio Cure 100.
h. W.R. Meadows, Inc; 1100-CLEAR.

F. Clear, Waterborne, Membrane-Forming, Curing Compound: ASTM C309, Type 1, Class B, 18 to 25 percent solids, nondissipating, certified by curing compound manufacturer to not interfere with bonding of floor covering.

1. Products: Subject to compliance with requirements, provide one of the following or approved equal:

a. BASF Corporation; MasterKure CC 180 WB.
b. ChemMasters, Inc; Polyseal WB.
c. Euclid Chemical Company (The); an RPM company; EverClear VOX.
d. Kaufman Products, Inc; Krystal 25 Emulsion.
e. Nox-Crete Products Group; Cure & Seal 200 E.
f. SpecChem, LLC; Cure & Seal WB 25.
g. Vexcon Chemicals Inc.; StarSeal 800.
h. W.R. Meadows, Inc; Vocomp-20.

G. Clear, Waterborne, Membrane-Forming, Curing and Sealing Compound: ASTM C1315, Type 1, Class A.

1. Products: Subject to compliance with requirements, provide one of the following or approved equal:

a. ChemMasters, Inc; Polyseal WB.
b. Euclid Chemical Company (The); an RPM company; Super Diamond Clear VOX.
c. Kaufman Products, Inc; Krystal 25 Emulsion.
d. Nox-Crete Products Group; Cure & Seal 250E.
e. SpecChem, LLC; Cure & Seal WB 25.
f. TK Products; TK-Bright Kure & Seal 1315 VOC.
g. Vexcon Chemicals Inc.; StarSeal 1315.
h. W.R. Meadows, Inc; Vocomp-30.

2. Verify products comply with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

2.9 RELATED MATERIALS

A. Expansion- and Isolation-Joint-Filler Strips: ASTM D1751, asphalt-saturated cellulosic fiber or ASTM D1752, cork or self-expanding cork.

B. Semirigid Joint Filler: Two-component, semirigid, 100 percent solids, epoxy resin with a Type A shore durometer hardness of 80 in accordance with ASTM D2240.

C. Bonding Agent: ASTM C1059, Type II, nonredispersible, acrylic emulsion or styrene butadiene. Use in strict conformance with manufacturer's written recommended application limitations, precautions, directions for use, including but not limited to surface preparation, mixing, placing, curing, and compatibility with substrate conditions.

D. Epoxy Bonding Adhesive: ASTM C881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade and class to suit requirements. Use in strict conformance with manufacturer's written recommended application limitations, precautions, directions for use, including but not limited to surface preparation, mixing, placing, curing, and compatibility with substrate conditions and as follows:

1. Types I and II, nonload bearing and Types IV and V, load bearing: for bonding hardened or freshly mixed concrete to hardened concrete.

2.10 REPAIR MATERIALS

A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch and that can be feathered at edges to match adjacent floor elevations.

1. Cement Binder: ASTM C150 portland cement or hydraulic or blended hydraulic cement, as defined in ASTM C219.
2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand, as recommended by underlayment manufacturer.
4. Compressive Strength: Not less than 5000 psi at 28 days when tested in accordance with ASTM C109.

B. Repair Overlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/4 inch and that can be filled in over a scarified surface to match adjacent floor elevations.

1. Cement Binder: ASTM C150 portland cement or hydraulic or blended hydraulic cement, as defined in ASTM C219.
2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.
3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by topping manufacturer.
4. Compressive Strength: Not less than 5000 psi at 28 days when tested in accordance with ASTM C109.

2.11 CONCRETE MIXTURES, GENERAL

A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, in accordance with ACI 301.

1. Use a qualified independent testing agency for preparing and reporting proposed mixture designs, based on laboratory trial mixtures.

B. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:

1. Fly Ash or Other Pozzolans: 25 percent by mass.
2. Slag Cement: 50 percent by mass.
3. Silica Fume: 10 percent by mass.
4. Total of Fly Ash or Other Pozzolans, Slag Cement, and Silica Fume: 50 percent by mass, with fly ash or pozzolans not exceeding 25 percent by mass and silica fume not exceeding 10 percent by mass.

C. Limit water-soluble chloride-ion content in hardened concrete to 0.15 percent by weight of cement.

D. Admixtures: Use admixtures in accordance with manufacturer's written instructions.

1. Use water-reducing, high-range water-reducing, or plasticizing admixture in concrete, as required, for placement and workability.
2. Use water-reducing and -retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
3. Use water-reducing admixture in pumped concrete and concrete with a w/cm below 0.50.

2.12 CONCRETE MIXTURES FOR BUILDING ELEMENTS

A. Footings, Piers: Normal-weight concrete.

1. Exposure Class: ACI 318 F0 S0 W0 C0.
2. Minimum Compressive Strength: 4000 psi at 28 days.
3. Maximum w/cm: 0.50.
4. Slump Limit: 4 inches, plus or minus 1 inch, and 8 inches, plus or minus 1 inch for concrete with verified slump of 3 inches, plus or minus 1 inch before adding high-range water-reducing admixture or plasticizing admixture at Project site.
5. Maximum Coarse Aggregate Size: 1-1/2-inch nominal.

B. Exterior Basement/Retaining Walls, Perimeter Knee Walls, Site Retaining Walls, Exterior Piers or Columns: Normal-weight concrete.

1. Exposure Class: ACI 318 F2 S0 W0 C1.
2. Minimum Compressive Strength: 5000 psi at 28 days.
3. Maximum w/cm: 0.45.
4. Slump Limit: 4 inches, plus or minus 1 inch, and 8 inches, plus or minus 1 inch for concrete with verified slump of 3 inches, plus or minus 1 inch, before adding high-range water-reducing admixture or plasticizing admixture at Project site.
5. Air Content: 6 percent, plus or minus 1.5 percent at point of delivery.
6. Maximum Coarse Aggregate Size: 3/4-inch nominal.

C. Interior Slabs-On-Grade: Normal-weight concrete.

1. Exposure Class: ACI 318 F0 S0 W0 C0.
2. Minimum Compressive Strength: 3500 psi at 28 days.
3. Maximum w/cm: 0.55.
4. Slump Limit: 4 inches, plus or minus 1 inch.
5. Air Content: Do not use an air-entraining admixture or allow total air content to exceed 3 percent for concrete used in trowel-finished floors. For slabs on grade in parking areas, 6 percent, plus or minus 1.5 percent at point of delivery.
6. Maximum Coarse-Aggregate Size: 3/4 inch, nominal. Finished floors to be colored, polished, or exposed to view as the final floor finish shall have a maximum coarse aggregate size of ½ inch.

D. Exterior, Exposed Slabs-on-Grade, Ramps, Stairs and Stoops, Interior Parking Slabs-on-Grade: Normal-weight concrete.

1. Exposure Class: ACI 318 F3 S0 W0 C2.
2. Minimum Compressive Strength: 5000 psi at 28 days.
3. Maximum w/cm: 0.40.
4. Slump Limit: 4 inches, plus or minus 1 inch.
5. Air Content: 6 percent, plus or minus 1.5 percent at point of delivery.
6. Maximum Coarse-Aggregate Size: 3/4 inch, nominal. Finished floors to be colored, polished, or exposed to view as the final floor finish shall have a maximum coarse aggregate size of ½ inch.

E. Interior Elevated Slabs on Metal Deck: Structural lightweight concrete.

1. Exposure Class: ACI 318 F0 S0 W0 C0.
2. Minimum Compressive Strength: 3500 psi at 28 days.
3. Calculated Equilibrium Unit Weight: 112 lb/cu. ft., plus or minus 3 lb/cu. ft. as determined by ASTM C567.
4. Slump Limit: 4 inches, plus or minus 1 inch.
5. Air Content:

    a. As recommended by the concrete supplier, but in no case shall be less than 4 percent or greater than 6 percent.

6. Maximum Coarse-Aggregate Size: 3/4 inch, nominal. Finished floors to be colored, polished, or exposed to view as the final floor finish shall have a maximum coarse aggregate size of ½ inch.

F. Interior Toppings: Normal-weight concrete.

1. Exposure Class: ACI 318 F0 S0 W0 C0.
2. Minimum Compressive Strength: 3500 psi at 28 days.
3. Maximum w/cm: 0.55.
4. Slump Limit: 4 inches, plus or minus 1 inch.
5. Air Content: Do not use an air-entraining admixture or allow total air content to exceed 3 percent for concrete used in trowel-finished floors.
6. Maximum Coarse-Aggregate Size: 3/4 inch, nominal. Finished floors to be colored, polished, or exposed to view as the final floor finish shall have a maximum coarse aggregate size of ½ inch.

2.13 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete in accordance with ASTM C94, and furnish batch ticket information.

B. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete in accordance with ASTM C94. Mix concrete materials in appropriate drum-type batch machine mixer.

1. For mixer capacity of 1 cu. yd. or smaller, continue mixing at least 1-1/2 minutes, but not more than five minutes after ingredients are in mixer, before any part of batch is released.
2. For mixer capacity larger than 1 cu. yd., increase mixing time by 15 seconds for each additional 1 cu. yd.
3. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mixture type, mixture time, quantity, and amount of water added. Record approximate location of final deposit in structure.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verification of Conditions:

1. Before placing concrete, verify that installation of concrete forms, accessories, and reinforcement, and embedded items is complete and that required inspections have been performed.
2. Do not proceed until unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Provide reasonable auxiliary services to accommodate field testing and inspections, acceptable to testing agency, including the following:

1. Daily access to the Work.
2. Incidental labor and facilities necessary to facilitate tests and inspections.
3. Secure space for storage, initial curing, and field curing of test samples, including source of water and continuous electrical power at Project site during site curing period for test samples.
4. Security and protection for test samples and for testing and inspection equipment at Project site.

B. Protection of In-Place Conditions:

1. Do not cut or puncture vapor retarder.
2. Repair damage and reseal vapor retarder before placing concrete.

C. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that reduce bond to concrete.

3.3 INSTALLATION OF VAPOR RETARDER

A. Sheet Vapor Retarders: Place, protect, and repair sheet vapor retarder in accordance with ASTM E1643 and manufacturer's written instructions.

1. Install vapor retarder with longest dimension parallel with direction of concrete pour.
2. Face laps away from exposed direction of concrete pour.
3. Lap vapor retarder over footings and grade beams not less than 6 inches, sealing vapor retarder to concrete.
4. Lap joints 6 inches and seal with manufacturer's recommended tape.
5. Terminate vapor retarder at the top of floor slabs, grade beams, and pile caps, sealing entire perimeter to floor slabs, grade beams, foundation walls, or pile caps.
6. Seal penetrations in accordance with vapor retarder manufacturer's instructions.
7. Protect vapor retarder during placement of reinforcement and concrete.

a. Repair damaged areas by patching with vapor retarder material, overlapping damages area by 6 inches on all sides, and sealing to vapor retarder.

B. Bituminous Vapor Retarders: Place, protect, and repair bituminous vapor retarder in accordance with manufacturer's written instructions.

3.4 INSTALLATION OF STEEL REINFORCEMENT

A. Comply with CRSI's "Manual of Standard Practice" for placing and supporting reinforcement.

B. Accurately position, support, and secure reinforcement against displacement.

1. Locate and support reinforcement with bar supports to maintain minimum concrete cover.
2. Do not tack weld crossing reinforcing bars.

C. Preserve clearance between bars of not less than 1 inch, not less than one bar diameter, or not less than 1-1/3 times size of large aggregate, whichever is greater.

D. Provide concrete coverage in accordance with ACI 301.

E. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

F. Splices: Lap splices as indicated on Drawings.

1. Bars indicated to be continuous, and all vertical bars shall be lapped per the Drawings.
2. Mechanical Splice Couplers: Install in accordance with manufacturer's instructions.
3. Weld reinforcing bars in accordance with AWS D1.4/D 1.4M, where indicated on Drawings.

G. Install welded-wire reinforcement in longest practicable lengths.

1. Support welded-wire reinforcement in accordance with CRSI "Manual of Standard Practice."

a. For reinforcement less than W4.0 or D4.0, continuous support spacing shall not exceed 12 inches.

2. Lap edges and ends of adjoining sheets at least one wire spacing plus 2 inches for plain wire and 8 inches for deformed wire.
3. Offset laps of adjoining sheet widths to prevent continuous laps in either direction.
4. Lace overlaps with wire.

3.5 JOINTS

A. Construct joints true to line, with faces perpendicular to surface plane of concrete.

B. Construction Joints: Coordinate with floor slab pattern and concrete placement sequence.

1. Install so strength and appearance of concrete are not impaired, at locations indicated on Drawings or as approved by Architect.
2. Place joints perpendicular to main reinforcement.

    a. Continue reinforcement across construction joints unless otherwise indicated.
    b. Do not continue reinforcement through sides of strip placements of floors and slabs.

3. Provide dowels across construction joints as indicated. Dowels shall be supported during concrete operations so as to remain parallel with slab or wall surface and perpendicular to the joint.
4. Form keyed joints as indicated. Embed keys at least 1-1/2 inches deep by one-third the thickness of the concrete wall or slab, continuous in walls, slabs, and between walls and footings, unless otherwise noted on drawings.
5. For structural beams, slabs, joists, and girders horizontal spacing of construction joints shall not exceed 90 feet in each direction. Locate joints for beams, slabs, joists, and girders at third points of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
6. For slabs on metal deck, horizontal spacing of construction joints shall not exceed 90 feet in each direction.
7. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
8. Space vertical joints in foundation walls as indicated on Drawings, or a maximum of 30’-0” on center, whichever is more stringent. Unless otherwise indicated on Drawings, locate vertical joints beside piers integral with walls, near corners, and in concealed locations where possible.
9. Shear walls with a length less than or equal to 30’-0” do not require vertical construction joints. Shear walls with a length greater than 30’-0” shall have a construction joint in the middle third of the wall length. Contractor shall submit proposed location of construction joints for Engineer’s review and approval.
10. Use epoxy-bonding adhesive at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
11. Where possible, avoid construction joints in areas specified to receive thin-set tile, terrazzo, or resilient floor finish materials. If unavoidable, Contractor shall coordinate the joint location with the Architect. Slab grinding, chipping, and filling at such occurrences to achieve specified floor tolerances will be at Contractor’s expense.

C. Contraction Joints in Slabs-on-Ground (also referred to as “Crack Control Joints”): Form weakened-plane control joints. Joints shall be placed at a maximum 15 feet on center in any direction, unless otherwise indicated by the documents, or written approval is given by the

Engineer. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness as follows:

1. Grooved Joints: Form control joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch. Repeat grooving of control joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.
2. Sawed Joints: Comply with recommendations of ACI 301. Form control joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- (3.2-mm-) wide joints into concrete when cutting action does not tear, abrade, or otherwise damage surface and before concrete develops random cracks.

    a. Initial saw cuts shall be performed no more than three hours after final surface finishing of the slab, with equipment specifically suited and designed for early concrete saw cutting (dry cut saw) without dislodging aggregate. Perform final saw cuts as soon as possible to achieve specified joint size.

D. Isolation Joints in Slabs-on-Ground: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.

1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface unless otherwise indicated on Drawings.
2. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.

E. Doweled Joints:

1. Install dowel bars and support assemblies at joints where indicated on Drawings.
2. Lubricate or asphalt coat one-half of dowel bar length to prevent concrete bonding to one side of joint.

3.6 CONCRETE PLACEMENT

A. Before placing concrete, verify that installation of formwork, reinforcement, embedded items, and vapor retarder is complete and that required inspections are completed.

1. Immediately prior to concrete placement, inspect vapor retarder for damage and deficient installation, and repair defective areas.
2. Provide continuous inspection of vapor retarder during concrete placement and make necessary repairs to damaged areas as Work progresses.

B. Notify Architect and testing and inspection agencies 24 hours prior to commencement of concrete placement.

C. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301, but not to exceed the amount indicated on the concrete delivery ticket.

1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.

D. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete is placed on concrete that has hardened enough to cause seams or planes of weakness.

1. If a section cannot be placed continuously, provide construction joints as indicated.
2. Deposit concrete to avoid segregation.
3. Deposit concrete in horizontal layers of depth not to exceed formwork design pressures and in a manner to avoid inclined construction joints.
4. Consolidate placed concrete with mechanical vibrating equipment in accordance with ACI 301.

    a. Do not use vibrators to transport concrete inside forms.
    b. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer.
    c. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity.
    d. At each insertion, limit duration of vibration to time necessary to consolidate concrete, and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.

E. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.

1. Do not place concrete floors and slabs in a checkerboard sequence.
2. Consolidate concrete during placement operations, so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
3. Maintain reinforcement in position on chairs during concrete placement.
4. Screed slab surfaces with a straightedge and strike off to correct elevations.
5. Level concrete, cut high areas, and fill low areas.
6. Slope surfaces uniformly to drains where required.
7. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface.
8. Do not further disturb slab surfaces before starting finishing operations.

3.7 FINISHING FORMED SURFACES

A. As-Cast Surface Finishes:

1. ACI 301 Surface Finish SF-1.0: As-cast concrete texture imparted by form-facing material.

    a. Patch voids larger than 1-1/2 inches wide or 1/2 inch deep.
    b. Remove projections larger than 1 inch.
    c. Tie holes do not require patching.
    d. Surface Tolerance: ACI 117 Class D.
    e. Apply to concrete surfaces not exposed to public view.

2. ACI 301 Surface Finish SF-2.0: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams.

    a. Patch voids larger than 3/4 inch wide or 1/2 inch deep.
    b. Remove projections larger than 1/8 inch (3 mm).

c. Patch tie holes.
d. Surface Tolerance: ACI 117 Class B.
e. Locations: Apply to concrete surfaces exposed to public view, to receive a rubbed finish, or to be covered with a coating or covering material applied directly to concrete.

B. Related Unformed Surfaces:

1. At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a color and texture matching adjacent formed surfaces.
2. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

3.8 FINISHING FLOORS AND SLABS

A. Comply with ACI 302.1R recommendations for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.

B. Scratch Finish:

1. While still plastic, texture concrete surface that has been screeded and bull-floated or darbied.
2. Use stiff brushes, brooms, or rakes to produce a profile depth of 1/4 inch in one direction.
3. Apply scratch finish to surfaces indicated, to receive concrete floor toppings, and to receive mortar setting beds for bonded cementitious floor finishes.

C. Float Finish:

1. When bleedwater sheen has disappeared and concrete surface has stiffened sufficiently to permit operation of specific float apparatus, consolidate concrete surface with power-driven floats or by hand floating if area is small or inaccessible to power-driven floats.
2. Repeat float passes and restraightening until surface is left with a uniform, smooth, granular texture and complies with ACI 117 tolerances for conventional concrete.
3. Apply float finish to surfaces indicated, to receive trowel finish and to be covered with fluid-applied or sheet waterproofing, built-up or membrane roofing, or sand-bed terrazzo.

D. Trowel Finish:

1. After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel.
2. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance.
3. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.
4. Do not add water to concrete surface.
5. Do not apply hard-troweled finish to concrete, which has a total air content greater than 3 percent.
6. Apply a trowel finish to surfaces indicated, exposed to view or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin-film-finish coating system.

7. Finish surfaces to the following tolerances, in accordance with ASTM E1155, for a randomly trafficked floor surface:

   a. Slabs on Ground:

      1) Specified overall values of flatness, F_F 35; and of levelness, F_L 25; with minimum local values of flatness, F_F 24; and of levelness, F_L 17.

   b. Suspended Slabs:

      1) Specified overall values of flatness, F_F 30; no limit for levelness, F_L; with minimum local values of flatness, F_F 24; no limit for levelness, F_L.

E. Trowel and Fine-Broom Finish: Apply a first trowel finish to surfaces indicated on Drawings and where ceramic or quarry tile is to be installed by either thickset or thinset method. While concrete is still plastic, slightly scarify surface with a fine broom perpendicular to main traffic route.

1. Coordinate required final finish with Architect before application.
2. Comply with flatness and levelness tolerances for trowel-finished floor surfaces.

F. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, ramps, and locations indicated on Drawings.

1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route.
2. Coordinate required final finish with Architect before application.

G. Rubbed Finish: Apply the following rubbed finish for Site Wall 1 – Cheek Wall, defined in ACI 301 (ACI 301M), to smooth-formed finished as -cast concrete where indicated:

1. Smooth Rubbed Finish.

3.9 INSTALLATION OF MISCELLANEOUS CONCRETE ITEMS

A. Filling In:

1. Fill in holes and openings left in concrete structures after Work of other trades is in place unless otherwise indicated.
2. Mix, place, and cure concrete, as specified, to blend with in-place construction.
3. Provide other miscellaneous concrete filling indicated or required to complete the Work.

B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.

C. Equipment Pads and Foundations: Normal weight concrete, unless otherwise noted.

1. Coordinate sizes and locations of concrete bases with actual equipment provided.
2. Construct concrete bases 4 inches high unless otherwise indicated on Drawings, and extend base not less than 6 inches in each direction beyond the maximum dimensions of

supported equipment unless otherwise indicated on Drawings, or unless required for seismic anchor support.

3. Minimum Compressive Strength: 5000 psi for exterior concrete bases, and 3500 psi for interior concrete bases, at 28 days.
4. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
5. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete substrate.
6. Prior to pouring concrete, place and secure anchorage devices.

    a. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
    b. Cast anchor-bolt insert into bases.
    c. Install anchor bolts to elevations required for proper attachment to supported equipment.

D. Steel Pan Stairs: Provide concrete fill for steel pan stair treads, landings, and associated items.

1. Cast-in inserts and accessories, as shown on Drawings.
2. Screed, tamp, and trowel finish concrete surfaces.

3.10 CONCRETE CURING

A. Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.

1. Comply with ACI 301 and ACI 306.1 for cold weather protection during curing.
2. Comply with ACI 301 and ACI 305.1 for hot-weather protection during curing.
3. Maintain moisture loss no more than 0.2 lb/sq. ft. x h (1 kg/sq. m x h), calculated in accordance with ACI 305.1, before and during finishing operations.

B. Curing Formed Surfaces: Comply with ACI 308.1 as follows:

1. Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces.
2.
3. If forms remain during curing period, moist cure after loosening forms.
4. If removing forms before end of curing period, continue curing for remainder of curing period, as follows:

    a. Continuous Fogging: Maintain standing water on concrete surface until final setting of concrete.
    b. Continuous Sprinkling: Maintain concrete surface continuously wet.
    c. Absorptive Cover: Pre-dampen absorptive material before application; apply additional water to absorptive material to maintain concrete surface continuously wet.
    d. Water-Retention Sheeting Materials: Cover exposed concrete surfaces with sheeting material, taping, or lapping seams.
    e. Membrane-Forming Curing Compound: Apply uniformly in continuous operation by power spray or roller in accordance with manufacturer's written instructions.

        1) Recoat areas subject to heavy rainfall within three hours after initial application.

2) Maintain continuity of coating and repair damage during curing period.

C. Curing Unformed Surfaces: Comply with ACI 308.1 as follows:

1. Begin curing immediately after finishing concrete.
2. Interior Concrete Floors:

a. Floors to Receive Floor Coverings Specified in Other Sections: Contractor has option of the following:

1) Absorptive Cover: As soon as concrete has sufficient set to permit application without marring concrete surface, install prewetted absorptive cover over entire area of floor.

a) Lap edges and ends of absorptive cover not less than 12-inches.
b) Maintain absorptive cover water saturated, and in place, for duration of curing period, but not less than seven days.

2) Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive.

a) Immediately repair any holes or tears during curing period, using cover material and waterproof tape.
b) Cure for not less than seven days.

3) Ponding or Continuous Sprinkling of Water: Maintain concrete surfaces continuously wet for not less than seven days, utilizing one, or a combination of, the following:

a) Water.
b) Continuous water-fog spray.

b. Floors to Receive Penetrating Liquid Floor Treatments: Contractor has option of the following:

1) Absorptive Cover: As soon as concrete has sufficient set to permit application without marring concrete surface, install prewetted absorptive cover over entire area of floor.

a) Lap edges and ends of absorptive cover not less than 12 inches.
b) Maintain absorptive cover water saturated, and in place, for duration of curing period, but not less than seven days.

2) Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive.

a) Immediately repair any holes or tears during curing period, using cover material and waterproof tape.
b) Cure for not less than seven days.

3) Ponding or Continuous Sprinkling of Water: Maintain concrete surfaces continuously wet for not less than seven days, utilizing one, or a combination of, the following:

a) Water.
b) Continuous water-fog spray.

c. Floors to Receive Curing Compound:

1) Apply uniformly in continuous operation by power spray or roller in accordance with manufacturer's written instructions.
2) Recoat areas subjected to heavy rainfall within three hours after initial application.
3) Maintain continuity of coating, and repair damage during curing period.
4) Removal: After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer unless manufacturer certifies curing compound does not interfere with bonding of floor covering used on Project.

d. Floors to Receive Curing and Sealing Compound:

1) Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller in accordance with manufacturer's written instructions.
2) Recoat areas subjected to heavy rainfall within three hours after initial application.
3) Repeat process 24 hours later, and apply a second coat. Maintain continuity of coating, and repair damage during curing period.

3.11 TOLERANCES

A. Conform to ACI 117.

3.12 APPLICATION OF LIQUID FLOOR TREATMENTS

A. Penetrating Liquid Floor Treatment: Prepare, apply, and finish penetrating liquid floor treatment in accordance with manufacturer's written instructions.

1. Remove curing compounds, sealers, oil, dirt, laitance, and other contaminants and complete surface repairs.
2. Do not apply to concrete that is less than three days' old as recommended in writing by liquid floor treatment manufacturer.
3. Apply liquid until surface is saturated, scrubbing into surface until a gel forms; rewet; and repeat brooming or scrubbing.
4. Rinse with water; remove excess material until surface is dry.
5. Apply a second coat in a similar manner if surface is rough or porous.

B. Sealing Coat: Uniformly apply a continuous sealing coat of curing and sealing compound to hardened concrete by power spray or roller in accordance with manufacturer's written instructions.

3.13 JOINT FILLING

A. Prepare, clean, and install joint filler in accordance with manufacturer's written instructions.

1. Defer joint filling until concrete has aged at least one month.
2. Do not fill joints until construction traffic has permanently ceased.

B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joints clean and dry.

C. Install semirigid joint filler full depth in saw-cut joints and at least 2 inches deep in formed joints.

D. Overfill joint, and trim joint filler flush with top of joint after hardening.

3.14 CONCRETE SURFACE REPAIRS

A. Defective Concrete:

1. Repair and patch defective areas when approved by Architect.
2. Remove and replace concrete that cannot be repaired and patched to Architect's approval.

B. Patching Mortar: Mix dry-pack patching mortar, consisting of 1 part portland cement to 2-1/2 parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.

C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.

1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension to solid concrete.

a. Limit cut depth to 3/4 inch.
b. Make edges of cuts perpendicular to concrete surface.
c. Clean, dampen with water, and brush-coat holes and voids with bonding agent.
d. Fill and compact with patching mortar before bonding agent has dried.
e. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.

2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement, so that, when dry, patching mortar matches surrounding color.

a. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching.
b. Compact mortar in place and strike off slightly higher than surrounding surface.

3. Repair defects on concealed formed surfaces that will affect concrete's durability and structural performance as determined by Architect.

D. Repairing Unformed Surfaces:

1. Test unformed surfaces, such as floors and slabs, for finish, and verify surface tolerances specified for each surface.

    a. Correct low and high areas.
    b. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.

2. Repair finished surfaces containing surface defects, including spalls, popouts, honeycombs, rock pockets, crazing, and cracks in excess of 0.01 inch wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
3. After concrete has cured at least 14 days, correct high areas by grinding.
4. Correct localized low areas during, or immediately after, completing surface-finishing operations by cutting out low areas and replacing with patching mortar.

    a. Finish repaired areas to blend into adjacent concrete.

5. Correct other low areas scheduled to receive floor coverings with a repair underlayment.

    a. Prepare, mix, and apply repair underlayment and primer in accordance with manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
    b. Feather edges to match adjacent floor elevations.

6. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete.

    a. Remove defective areas with clean, square cuts, and expose steel reinforcement with at least a 3/4-inch clearance all around.
    b. Dampen concrete surfaces in contact with patching concrete and apply bonding agent.
    c. Mix patching concrete of same materials and mixture as original concrete, except without coarse aggregate.
    d. Place, compact, and finish to blend with adjacent finished concrete.
    e. Cure in same manner as adjacent concrete.

7. Repair random cracks and single holes 1 inch or less in diameter with patching mortar.

    a. Groove top of cracks and cut out holes to sound concrete, and clean off dust, dirt, and loose particles.
    b. Dampen cleaned concrete surfaces and apply bonding agent.
    c. Place patching mortar before bonding agent has dried.
    d. Compact patching mortar and finish to match adjacent concrete.
    e. Keep patched area continuously moist for at least 72 hours.

E. Perform structural repairs of concrete, subject to Architect's approval, using epoxy adhesive and patching mortar.

F. Repair materials and installation not specified above may be used, subject to Architect's approval.

3.15 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a special inspector to perform field tests and inspections and prepare testing and inspection reports.

B. Testing Agency: Owner will engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.

1. Testing agency shall be responsible for providing curing container for composite samples on Site and verifying that field-cured composite samples are cured in accordance with ASTM C31.
2. Testing agency shall immediately report to Architect, Contractor, and concrete manufacturer any failure of Work to comply with Contract Documents.
3. Testing agency shall report results of tests and inspections, in writing, to Owner, Architect, Contractor, and concrete manufacturer within 48 hours of inspections and tests.

a. Test reports shall include reporting requirements of ASTM C31, ASTM C39, and ACI 301, including the following as applicable to each test and inspection:

1) Project name.
2) Name of testing agency.
3) Names and certification numbers of field and laboratory technicians performing inspections and testing.
4) Name of concrete manufacturer.
5) Date and time of inspection, sampling, and field testing.
6) Date and time of concrete placement.
7) Location in Work of concrete represented by samples.
8) Date and time sample was obtained.
9) Truck and batch ticket numbers.
10) Design compressive strength at 28 days.
11) Concrete mixture designation, proportions, and materials.
12) Field test results.
13) Information on storage and curing of samples before testing, including curing method and maximum and minimum temperatures during initial curing period.
14) Type of fracture and compressive break strengths at seven days and 28 days.

C. Batch Tickets: For each load delivered, submit three copies of batch delivery ticket to testing agency, indicating quantity, mix identification, admixtures, design strength, aggregate size, design air content, design slump at time of batching, and amount of water that can be added at Project site.

D. Inspections:

1. Headed bolts and studs.
2. Steel-reinforcement placement.
3. Steel reinforcement mechanical splice couplers.
4. Steel-reinforcement welding.
5. Verification of use of required design mixture.
6. Concrete placement, including conveying and depositing.
7. Curing procedures and maintenance of curing temperature.

8. Verification of concrete strength before removal of shores and forms from beams and slabs.
9. Batch Plant Inspections: On a random basis, as determined by Architect.

E. Concrete Tests: Testing of composite samples of fresh concrete obtained in accordance with ASTM C 172 shall be performed in accordance with the following requirements:

1. Testing Frequency: Obtain at least one composite sample for each 100 cu. yd. or fraction thereof of each concrete mixture placed each day.

    a. When frequency of testing provides fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.

2. Slump: ASTM C143:

    a. One test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture.
    b. Perform additional tests when concrete consistency appears to change.

3. Slump Flow: ASTM C1611:

    a. One test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture.
    b. Perform additional tests when concrete consistency appears to change.

4. Air Content: ASTM C231 pressure method, for normal-weight concrete; ASTM C173 volumetric method, for structural lightweight concrete.

    a. One test for each composite sample, but not less than one test for each day's pour of each concrete mixture.

5. Concrete Temperature: ASTM C1064:

    a. One test hourly when air temperature is 40 deg F and below or 80 deg F and above, and one test for each composite sample.

6. Unit Weight: ASTM C567 fresh unit weight of structural lightweight concrete.

    a. One test for each composite sample, but not less than one test for each day's pour of each concrete mixture.

7. Compression Test Specimens: ASTM C31:

    a. Cast and laboratory cure three sets of two 6-inch by 12-inch or three 4-inch by 8-inch cylinder specimens for each composite sample.
    b. Cast, initial cure, and field cure two sets of two 6-inch by 12-inch or three 4-inch by 8-inch cylinder specimens for each composite sample.

8. Compressive-Strength Tests: ASTM C39.

    a. Test one set of two 6-inch by 12-inch or three 4-inch by 8-inch laboratory-cured specimens at seven days and one set of specimens at 28 days.

b. Retain one set of two 6-inch by 12-inch or three 4-inch by 8-inch laboratory-cured specimens for 56 days.
c. Test one set of two 6-inch by 12-inch or three 4-inch by 8-inch field-cured specimens at contractor's option of seven days or earlier and one set of specimens at 28 days.
d. A compressive-strength test shall be the average compressive strength from a set of specimens obtained from same composite sample and tested at age indicated.

9. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.
10. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength, and no compressive-strength test value falls below specified compressive strength by more than 500 psi if specified compressive strength is 5000 psi, or no compressive strength test value is less than 10 percent of specified compressive strength if specified compressive strength is greater than 5000 psi.
11. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.
12. Additional Tests:

    a. Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect.
    b. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C42 or by other methods as directed by Architect.

        1) Acceptance criteria for concrete strength shall be in accordance with ACI 301, section 1.6.6.3.

13. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
14. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.

F. Measure floor and slab flatness and levelness in accordance with ASTM E1155 within 24 hours of completion of floor finishing and promptly report test results to Architect.

3.16 PROTECTION

A. Protect concrete surfaces as follows:

1. Protect from petroleum stains.
2. Diaper hydraulic equipment used over concrete surfaces.
3. Prohibit vehicles from interior concrete slabs.
4. Prohibit use of pipe-cutting machinery over concrete surfaces.
5. Prohibit placement of steel items on concrete surfaces.
6. Prohibit use of acids or acidic detergents over concrete surfaces.

END OF SECTION

SECTION 03 45 00 - PRECAST ARCHITECTURAL CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

A. Description of Work: Precast architectural wall cladding in profiles and with joints indicated including decorative panels and inscriptions. Provide precast architectural wall panels in two finishes: PC-1, an acid-etched smooth finish to simulate Indiana Limestone Buff Select and PC-2, an acid-etched smooth subtle multi-colored, rusticated variable gray-buff finish to simulate variegated Indiana Limestone, both to match Design Reference Samples.

B. Section Includes:

1. Precast architectural concrete units.
2. Mold materials.
3. Reinforcing materials.
4. Concrete materials.
5. Steel connection materials.
6. Accessories.
7. Grout materials.

C. Related Requirements:

1. Section 071900 "Water Repellents" for water-repellent finish treatments to be applied to all precast architectural concrete panels.
2. Section 076200 “Sheet Metal Flashing and Trim” for reglets to be cast into precast architectural concrete.
3. Section 118131 “Facility Fall Protection and Façade Access Equipment” for fall restraint anchors to be cast into precast architectural concrete.

1.2 COORDINATION

A. Coordinate location of items to be cast into precast architectural concrete including reglets, fall restraint anchors, and junction boxes required for electrical and security devices including, but not limited to, lights, card readers, and cameras.

1.3 DEFINITIONS

A. Design Reference Sample: Sample of approved architectural precast concrete color, finish, and texture, preapproved by Architect.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.5 ACTION SUBMITTALS

A. Product Data:

1. Precast architectural concrete unit design mixtures: Include compressive strength and water-absorption tests for each precast concrete mixture.
2. Mold materials.
3. Reinforcing materials.
4. Concrete materials.
5. Steel connection materials.
6. Accessories.
7. Grout materials.

B. Shop Drawings:

1. Detail fabrication and installation of architectural precast concrete units.
2. Indicate locations, plans, elevations, dimensions, shapes, and cross sections of each unit.
3. Indicate joints, reveals, drips, chamfers, and extent and location of each surface finish.
4. Indicate details at building corners.
5. Indicate separate face and backup mixture locations and thicknesses.
6. Indicate type, size, and length of welded connections by AWS standard symbols. Detail loose and cast-in hardware and connections.
7. Indicate locations, tolerances, and details of anchorage devices to be embedded in or attached to structure or other construction.
8. Include plans and elevations showing unit locations, dimensions, erection sequences, and bracing plans for special conditions.
9. Indicate location of each architectural precast concrete unit by same identification mark placed on panel.
10. Indicate relationship of architectural precast concrete units to adjacent materials.
11. Indicate locations, type, dimensions, and details of facing units, including corner units, special shapes, joint treatment, and anchors.
12. Coordinate and indicate openings and inserts required by other trades.
13. If design modifications are proposed to meet performance requirements and field conditions, submit design calculations and indicate modified areas on Shop Drawings. Do not adversely affect the appearance, durability, or strength of units.

C. Samples: Design reference samples for initial verification of design intent, for each type of finish indicated on exposed surfaces of architectural precast concrete units, in sets of three, representative of finish, color, and texture variations expected; approximately 12 by 12 by 2 inches.

D. Sample Panels: After sample approval and before fabricating architectural precast concrete units, produce a minimum of three sample panels approximately 16 sq. ft. in area for review by Architect. Incorporate full-scale details of architectural features, finishes, textures, and transitions in sample panels.

1. Locate panels where indicated or, if not indicated, as directed by Architect.
2. Damage part of an exposed-face surface for each finish, color, and texture, and demonstrate adequacy of repair techniques proposed for repair of surface blemishes.
3. After acceptance of repair technique, maintain one sample panel at manufacturer's plant and one at Project site in an undisturbed condition as a standard for judging the completed Work.

4. Demolish and remove sample panels when directed.

E. Range Samples: After sample panel approval and before fabricating architectural precast concrete units, produce a minimum of five sets of samples, approximately 16 sq. ft. in area, representing anticipated range of each color and texture on Project's units. Maintain one set of range samples at Project site and remaining sets at manufacturer's plant as color and texture approval reference.

F. Delegated Design Submittals: For architectural precast concrete indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Show governing panel types, connections, types of reinforcement, including special reinforcement, and concrete cover on reinforcement. Indicate location, type, magnitude, and direction of loads imposed on the building structural frame from architectural precast concrete.

G. Sustainable Design Submittals:

1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.
2. Environmental product declaration.
3. Sourcing of Raw Materials: Corporate sustainability report.

1.6 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Provide locations, setting diagrams, templates, instructions, and directions, as required, for furnishing and installation of loose connection hardware and anchorage items to be embedded in or attached to other construction.

B. Welding certificates.

C. Material Test Reports: For each of the following items, for tests performed by manufacturer, qualified testing agency, or manufacturer and witnessed by a qualified testing agency.

1. Aggregates.
2. Cementitious materials.
3. Reinforcing materials.
4. Admixtures.
5. Bearing pads.

D. Qualification Statements: For fabricator.

1.7 QUALITY ASSURANCE

A. Fabricator Qualifications: A firm that assumes responsibility for engineering architectural precast concrete units to comply with performance requirements. This responsibility includes preparation of Shop Drawings and comprehensive engineering analysis by a qualified professional engineer.

1. Designated at time of bidding as a PCI-certified plant for Category AA.

B. Certified Installer Qualifications: A precast concrete erector qualified and designated by PCI's Certificate of Compliance to erect Category A (Architectural Systems) for non-load-bearing members including providing a Field Quality Audit Report (FQAR) and an Erector Post Audit Declaration (EPAD).

C. Delegated Design Engineer Qualifications: A professional engineer who is legally qualified to practice in state where Project is located and who is experienced in providing engineering services of the type indicated.

D. Welding Qualifications: Qualify procedures and personnel in accordance with the following welding codes:

1. AWS D1.1/D1.1M.
2. AWS D1.4/D1.4M.

1.8 MOCKUPS

A. Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, to set quality standards for materials and execution, and for preconstruction testing.

1. After sample panel and range sample approval, build integrated exterior mockup as indicated on Drawings and specified in Section 01 43 39, complete with anchors, connections, flashings, and joint fillers.
2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Owner specifically approves such deviations by Change Order.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Deliver architectural precast concrete units in such quantities and at such times to limit unloading units temporarily on the ground or other rehandling.

B. Support units during shipment on nonstaining shock-absorbing material.

C. Store units with adequate dunnage and bracing, and protect units to prevent contact with soil, prevent staining, and prevent cracking, distortion, warping, or other physical damage.

D. Place stored units so identification marks are clearly visible, and units can be inspected.

E. Handle and transport units in a manner that avoids excessive stresses that cause cracking or damage.

F. Lift and support units only at designated points indicated on Shop Drawings.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design architectural precast concrete units.

B. Design Standards: Comply with ACI 318 and design recommendations of PCI MNL 120 applicable to types of architectural precast concrete units indicated.

C. Structural Performance: Provide architectural precast concrete units and connections capable of withstanding the following design loads within limits and under conditions indicated:

1. Loads: As indicated on Drawings.
2. Design precast concrete units and connections to maintain clearances at openings, to allow for fabrication and construction tolerances, to accommodate live-load deflection, shrinkage and creep of primary building structure, and other building movements.
3. Thermal Movements: Provide for in-plane thermal movements resulting from annual ambient temperature changes of 120 deg F.

2.2 PRECAST ARCHITECTURAL CONCRETE UNITS

A. Provide unit types as indicated on Drawings.

B. Source Limitations: Obtain precast architectural concrete units from single fabricator.

2.3 MOLD MATERIALS

A. Molds: Rigid, dimensionally stable, nonabsorptive material, warp and buckle free, that provides continuous and true precast concrete surfaces within fabrication tolerances indicated; nonreactive with concrete and suitable for producing required finishes.

B. Form-Release Agent: Commercially produced form-release agent that does not bond with, stain, or adversely affect precast concrete surfaces and does not impair subsequent surface or joint treatments of precast concrete.

2.4 REINFORCING MATERIALS

A. Recycled Content of Steel Products: Provide products with postconsumer recycled content plus one-half of preconsumer recycled content to the extent required to comply with the minimum criteria specified in Section 01 81 13.14 “Sustainable Design Requirements.”

B. Reinforcing Bars: ASTM A615/A615M, Grade 60, deformed.

C. Steel Bar Mats: ASTM A184/A184M, fabricated from ASTM A615/A615M, Grade 60, deformed bars, assembled with clips.

D. Plain-Steel Welded-Wire Reinforcement: ASTM A1064/A1064M, fabricated from as-drawn steel wire into flat sheets.

E. Deformed-Steel Welded-Wire Reinforcement: ASTM A1064/A1064M, flat sheet.

F. Supports: Suspend reinforcement from back of mold. Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcement in place may only be used if they are not visible in the finished face.

2.5 CONCRETE MATERIALS

A. Regional Materials: To the extent required to comply with the minimum project-wide criteria specified in Section 01 81 13.14 “Sustainable Design Requirements,” verify concrete is manufactured within 100 miles of Project site from aggregates that have been extracted, harvested, or recovered, as well as manufactured, within 100 miles of Project site.

B. Portland Cement: ASTM C150/C150M, Type I or Type III.

1. For surfaces exposed to view in finished structure, use cement, of same type, brand, and mill source.

C. Normal-Weight Aggregates: Except as modified by PCI MNL 117, ASTM C33/C33M, with coarse aggregates complying with Class 5S. Stockpile fine and coarse aggregates for each type of exposed finish from a single source (pit or quarry) for Project.

1. Face-Mixture-Coarse Aggregates: Selected, hard, and durable; free of material that reacts with cement or causes staining; to match approved finish sample.

a. Gradation: To match design reference sample.

2. Face-Mixture-Fine Aggregates: Selected, natural or manufactured sand compatible with coarse aggregate; to match approved finish sample.

D. Coloring Admixture: ASTM C979/C979M, synthetic or natural mineral-oxide pigments or colored water-reducing admixtures, temperature stable, and nonfading.

E. Water: Potable; free from deleterious material that may affect color stability, setting, or strength of concrete and complying with chemical limits of PCI MNL 117.

F. Air-Entraining Admixture: ASTM C260/C260M, certified by manufacturer to be compatible with other required admixtures.

G. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures and to not contain calcium chloride, or more than 0.15 percent chloride ions or other salts by weight of admixture.

1. Water-Reducing Admixtures: ASTM C494/C494M, Type A.
2. Retarding Admixture: ASTM C494/C494M, Type B.
3. Water-Reducing and -Retarding Admixture: ASTM C494/C494M, Type D.
4. Water-Reducing and -Accelerating Admixture: ASTM C494/C494M, Type E.
5. High-Range, Water-Reducing Admixture: ASTM C494/C494M, Type F.
6. High-Range, Water-Reducing and -Retarding Admixture: ASTM C494/C494M, Type G.
7. Plasticizing Admixture: ASTM C1017/C1017M, Type I.
8. Plasticizing and Retarding Admixture: ASTM C1017/C1017M, Type II.
9. Corrosion-Inhibiting Admixture: ASTM C1582/C1582M.

2.6 STEEL CONNECTION MATERIALS

A. Carbon Steel Shapes and Plates: ASTM A36/A36M.

B. Carbon Steel-Headed Studs: ASTM A108, Grades 1010 through 1020, cold finished, AWS D1.1/D1.1M, Type A or Type B, with arc shields and with minimum mechanical properties of PCI MNL 117, Table 3.2.3.

C. Carbon Steel Plate: ASTM A283/A283M, Grade C.

D. Malleable Iron Castings: ASTM A47/A47M, Grade 32510 or Grade 35028.

E. Carbon Steel Castings: ASTM A27/A27M, Grade 60-30.

F. High-Strength, Low-Alloy Structural Steel: ASTM A572/A572M.

G. Carbon Steel Structural Tubing: ASTM A500/A500M, Grade B or Grade C.

H. Wrought Carbon Steel Bars: ASTM A675/A675M, Grade 65.

I. Deformed-Steel Wire or Bar Anchors: ASTM A1064/A1064M or ASTM A706/A706M.

J. Carbon Steel Bolts and Studs: ASTM A307, Grade A, or ASTM F1554, Grade 36; carbon steel, hex-head bolts and studs; carbon steel nuts, ASTM A563; and flat, unhardened steel washers, ASTM F844.

K. High-Strength Bolts, Nuts, and Washers: ASTM F3125/F3125M, Grade A325, Type 1, heavy-hex steel structural bolts; ASTM A563, Grade DH, heavy-hex carbon steel nuts; and ASTM F436/F436M, Type 1, hardened carbon steel washers.

L. Welding Electrodes: Comply with AWS standards.

2.7 ACCESSORIES

A. Bearing Pads: Provide one of the following for architectural precast concrete units as recommended by precast fabricator for application:

1. Elastomeric Pads: AASHTO M 251, plain, vulcanized, 100 percent polychloroprene (neoprene) elastomer, molded to size or cut from a molded sheet, Type A durometer hardness of 50 to 70, ASTM D2240, minimum tensile strength 2250 psi, ASTM D412.
2. Random-Oriented-Fiber-Reinforced Elastomeric Pads: Preformed, randomly oriented synthetic fibers set in elastomer; Type A durometer hardness of 70 to 90, ASTM D2240; capable of supporting a compressive stress of 3000 psi with no cracking, splitting, or delaminating in the internal portions of pad. Test one specimen for every 200 pads used in Project.
3. Cotton-Duck-Fabric-Reinforced Elastomeric Pads: Preformed, horizontally layered cotton-duck fabric bonded to an elastomer; Type A durometer hardness of 80 to 100, ASTM D2240; in compliance with AASHTO LRFDBDS, Division II, Section 18 .1 0.2; or with MIL-C-882E.
4. Frictionless Pads: PTFE, glass-fiber reinforced, bonded to stainless or mild-steel plate, or random-oriented-fiber-reinforced elastomeric pads; of type required for in-service stress.
5. High-Density Plastic: Multimonomer, nonleaching, plastic strip.

B. Precast Accessories: Provide clips, hangers, high-density plastic or steel shims, and other accessories required to install architectural precast concrete units.

2.8 GROUT MATERIALS

A. Nonmetallic, Nonshrink Grout: Packaged, nonmetallic, noncorrosive, nonstaining grout containing selected silica sands, portland cement, shrinkage-compensating agents, plasticizing and water-reducing agents, complying with ASTM C1107/C1107M, Grade A for dry pack and Grades B and C for flowable grout, and of consistency suitable for application within a 30-minute working time. Water-soluble chloride ion content is to be less than 0.06 percent by weight of cement when tested in accordance with ASTM C1218/C1218M.

2.9 CONCRETE MIXTURES

A. Prepare design mixtures for each type of precast concrete required.

1. Use a single design mixture for units with more than one major face or edge exposed.
2. Where only one face of unit is exposed, use either a single design mixture or separate mixtures for face and backup.

B. Design mixtures may be prepared by a qualified independent testing agency or by qualified precast plant personnel at architectural precast concrete fabricator's option.

C. Limit water-soluble chloride ions to maximum percentage by weight of cement permitted by ACI 318 or PCI MNL 117 when tested in accordance with ASTM C1218/C1218M.

D. Normal-Weight Concrete Mixtures: Proportion face and backup mixtures or full-depth mixtures, at fabricator's option by either laboratory trial batch or field test data methods in accordance with ACI 211.1, with materials to be used on Project, to provide normal-weight concrete with the following properties:

1. Compressive Strength (28 Days): 4500 psi minimum.
2. Maximum Water-Cementitious Materials Ratio: 0.45.

E. Water Absorption: Six percent by weight or 14 percent by volume, tested in accordance with ASTM C642, except for boiling requirement.

F. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having an air content complying with PCI MNL 117.

G. When included in design mixtures, add other admixtures to concrete mixtures in accordance with manufacturer's written instructions.

2.10 FABRICATION OF MOLDS

A. Molds: Accurately construct molds, mortar tight, of sufficient strength to withstand pressures due to concrete-placement operations and temperature changes. Coat contact surfaces of molds with release agent before reinforcement is placed. Avoid contamination of reinforcement by release agent.

B. Maintain molds to provide completed architectural precast concrete units of shapes, lines, and dimensions indicated, within fabrication tolerances specified.

1. Form joints are not permitted on faces exposed to view in the finished Project.
2. Edge and Corner Treatment: Uniformly eased, as indicated on Drawings.

2.11 FABRICATION OF PRECAST ARCHITECTURAL CONCRETE

A. Cast-in Anchors, Inserts, Plates, Angles, and Other Anchorage Hardware: Fabricate anchorage hardware with sufficient anchorage and embedment to comply with design requirements. Accurately position for attachment of loose hardware, and secure in place during precasting operations. Locate anchorage hardware where it does not affect position of main reinforcement or concrete placement.

1. Weld-headed studs and deformed bar anchors used for anchorage in accordance with AWS D1.1/D1.1M and AWS C5.4.

B. Furnish loose hardware items, including steel plates, clip angles, seat angles, anchors, dowels, cramps, hangers, and other hardware shapes for securing architectural precast concrete units to supporting and adjacent construction.

C. Cast-in reglets, slots, holes, and other accessories in architectural precast concrete units, as indicated on the Drawings.

D. Cast-in openings larger than 10 inches in any dimension. Do not drill or cut openings without Architect's approval.

E. Reinforcement: Comply with recommendations in PCI MNL 117 for fabricating, placing, and supporting reinforcement.

1. Clean reinforcement of loose rust and mill scale, earth, and other materials that reduce or destroy the bond with concrete. When damage to epoxy-coated reinforcing exceeds limits specified in ASTM A775/A775M, repair with patching material compatible with coating material and epoxy coat bar ends after cutting.
2. Accurately position, support, and secure reinforcement against displacement during concrete-placement and consolidation operations. Completely conceal support devices to prevent exposure on finished surfaces.
3. Place reinforcing steel to maintain at least 3/4-inch minimum concrete cover. Increase cover requirements for reinforcing steel to 1-1/2 inches when units are exposed to corrosive environment or severe exposure conditions. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position while placing concrete. Direct wire tie ends away from finished, exposed concrete surfaces.
4. Install welded-wire reinforcement in lengths as long as practicable. Lap adjoining pieces at least one full mesh spacing and wire tie laps, where required by design. Offset laps of adjoining widths to prevent continuous laps in either direction.

F. Reinforce architectural precast concrete units to resist handling, transportation, and erection stresses and specified in-place loads.

G. Comply with requirements in PCI MNL 117 and requirements in this Section for measuring, mixing, transporting, and placing concrete. After concrete batching, no additional water may be added.

H. Place face mixture to a minimum thickness after consolidation of the greater of 1 inch or 1.5 times the maximum aggregate size, but not less than the minimum reinforcing cover specified.

I. Place concrete in a continuous operation to prevent cold joints or planes of weakness from forming in precast concrete units.

1. Place backup concrete mixture to ensure bond with face-mixture concrete.

J. Thoroughly consolidate placed concrete by internal and external vibration without dislocating or damaging reinforcement and built-in items, and minimize pour lines, honeycombing, or entrapped air voids on surfaces. Use equipment and procedures complying with PCI MNL 117.

1. Place self-consolidating concrete without vibration in accordance with PCI TR-6. Ensure adequate bond between face and backup concrete, if used.

K. Comply with PCI MNL 117 for hot- and cold-weather concrete placement.

L. Identify pickup points of architectural precast concrete units and orientation in structure with permanent markings, complying with markings indicated on Shop Drawings. Imprint or permanently mark casting date on each architectural precast concrete unit on a surface that does not show in finished structure.

M. Cure concrete, in accordance with PCI MNL 117, by moisture retention without heat or by accelerated heat curing using low-pressure live steam or radiant heat and moisture. Cure units until compressive strength is high enough to ensure that stripping does not have an effect on performance or appearance of final product.

N. Discard and replace architectural precast concrete units that do not comply with requirements, including structural, manufacturing tolerance, and appearance, unless repairs comply with requirements in PCI MNL 117 and Architect's approval.

2.12 FABRICATION TOLERANCES

A. Fabricate architectural precast concrete units to shapes, lines, and dimensions indicated so each finished unit complies with PCI MNL 135 product tolerances for Category AA as well as position tolerances for cast-in items.

2.13 FINISHES

A. Exposed faces to be free of joint marks, grain, and other obvious defects. Corners, including false joints to be uniform, straight, and sharp. Finish exposed-face surfaces of architectural precast concrete units to match approved design reference sample and as follows:

1. Design Reference Samples:

a. PC-1, an acid-etched smooth finish to simulate Indiana Limestone Buff Select; Sample OA-A1 by Gate Precast.
b. PC-2, an acid-etched smooth subtle multi-colored, rusticated variable gray-buff finish to simulate variegated Indiana Limestone' Sample OA-B1 by Gate Precast

2. Acid-Etched Finish: Use acid and hot-water solution, equipment, application techniques, and cleaning procedures to expose aggregate and surrounding matrix surfaces. Protect hardware, connections, and insulation from acid attach.

B. Finish exposed surfaces of architectural precast concrete units to match face-surface finish.

C. Finish unexposed surfaces of architectural precast concrete units with as-cast finish.

D. Finish exposed back of parapets with trowel finish.

2.14 SOURCE QUALITY CONTROL

A. Quality-Control Testing: Test and inspect precast concrete in accordance with PCI MNL 117 requirements. If using self-consolidating concrete, also test and inspect in accordance with PCI TR-6, ASTM C1610/C1610M, ASTM C1611/C1611M, ASTM C1621/C1621M, and ASTM C1712.

B. Strength of precast concrete units is considered deficient if units fail to comply with ACI 318 requirements for concrete strength.

C. Defective Units: Discard and replace recast architectural concrete units that do not comply with acceptability requirements in PCI MNL 117, including concrete strength, manufacturing tolerances, and color and texture range. Chipped, spalled, or cracked units may be repaired, subject to Architect's approval. Architect reserves the right to reject precast units that do not match approved samples, sample panels, and mockups. Replace unacceptable units with precast concrete units that comply with requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine supporting structural frame or foundation and conditions for compliance with requirements for installation tolerances, bearing surface tolerances, and other conditions affecting performance of the Work.

B. Do not install precast concrete units until supporting cast-in-place concrete has attained minimum allowable design compressive strength and supporting steel or other structure is structurally ready to receive loads from precast concrete units.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF PRECAST ARCHITECTURAL CONCRETE UNITS

A. Install clips, hangers, bearing pads, and other accessories required for connecting architectural precast concrete units to supporting members and backup materials.

B. Erect architectural precast concrete level, plumb, and square within specified allowable tolerances. Provide temporary supports and bracing as required to maintain position, stability, and alignment of units until permanent connections are completed.

1. Install temporary steel or plastic spacing shims as precast concrete units are being erected. Tack weld steel shims to each other to prevent shims from separating.
2. Maintain horizontal and vertical joint alignment and uniform joint width as erection progresses.
3. Remove projecting lifting devices and grout fill voids within recessed lifting devices flush with surface of adjacent precast surfaces when recess is exposed.
4. Maintain uniform joint widths indicated and approved on Shop Drawings.

C. Connect architectural precast concrete units in position by bolting, welding, grouting, or as otherwise indicated on Shop Drawings. Remove temporary shims, wedges, and spacers as soon as practical after connecting and grouting are completed.

1. Do not permit connections to disrupt continuity of roof flashing.

D. Welding: Comply with applicable requirements in AWS D1.1/D1.1M and AWS D1.4/D1.4M for welding, welding electrodes, appearance, quality of welds, and methods used in correcting welding work.

1. Protect architectural precast concrete units and bearing pads from damage by field welding or cutting operations, and provide noncombustible shields as required.
2. Welds not specified to be continuous fillet welds use no less than the minimum fillet as specified by AWS.
3. Clean weld-affected metal surfaces with chipping hammer followed by brushing, and apply a minimum 4.0-mil-thick coat of galvanized repair paint to galvanized surfaces in accordance with ASTM A780/A780M.
4. Visually inspect welds and remove, reweld, or repair incomplete and defective welds.

E. At bolted connections, use lock washers, tack welding, or other approved means to prevent loosening of nuts after final adjustment.

1. Where slotted connections are used, verify bolt position and tightness. For sliding connections, properly secure bolt but allow bolt to move within connection slot.
2. For slip-critical connections, use one of the following methods to assure proper bolt pretension:

    a. Turn-of-Nut: In accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts."
    b. Calibrated Wrench: In accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts."
    c. Twist-off Tension Control Bolt: ASTM F3125/F3125M, Grade 1852.
    d. Direct-Tension Control Bolt: ASTM F3125/F3125M, Grade 1852.

3. For slip-critical connections, use method and inspection procedure approved by Architect and coordinated with inspection agency.

F. Grouting or Dry Packing Connections and Joints: Grout connections where required or indicated. Retain flowable grout in place until hard enough to support itself. Alternatively, pack spaces with stiff dry pack grout material, tamping until voids are completely filled. Place grout and finish smooth, level, and plumb with adjacent concrete surfaces. Promptly remove grout material from exposed surfaces before it affects finishes or hardens. Keep grouted joints damp for not less than 24 hours after initial set.

3.3 ERECTION TOLERANCES

A. Erect architectural precast concrete units level, plumb, square, and in alignment without exceeding the noncumulative erection tolerances of PCI MNL 135.

3.4 REPAIR

A. Repair architectural precast concrete units if permitted by Architect. Architect reserves the right to reject repaired units that do not comply with requirements.

B. Mix patching materials and repair units so cured patches blend with color, texture, and uniformity of adjacent exposed surfaces and show no apparent line of demarcation between original and repaired work, when viewed in typical daylight illumination from a distance of 10 ft..

C. Prepare and repair damaged galvanized coatings with galvanizing repair paint in accordance with ASTM A780/A780M.

D. Wire brush, clean, and paint damaged prime-painted components with same type of shop primer.

E. Remove and replace damaged architectural precast concrete units when repairs do not comply with requirements.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Tests and Inspections:

1. Visually inspect field welds and test in accordance with ASTM E165/E165M or to ASTM E709 and ASTM E1444/E1444M.
2. High-strength bolted connections are subject to inspections.

C. Prepare test and inspection reports.

D. Repair or remove and replace work where tests and inspections indicate that it does not comply with specified requirements.

E. Additional testing and inspecting, at Contractor's expense, to be performed to determine compliance of replaced or additional work with specified requirements.

3.6 CLEANING

A. Clean surfaces of precast concrete units exposed to view.

B. Clean mortar, plaster, fireproofing, weld slag, and other deleterious material from concrete surfaces and adjacent materials immediately.

C. Clean exposed surfaces of precast concrete units after erection and completion of joint treatment to remove weld marks, other markings, dirt, and stains.

1. Perform cleaning procedures, if necessary, in accordance with precast concrete fabricator's recommendations. Protect other work from staining or damage due to cleaning operations.
2. Do not use cleaning materials or processes that could change the appearance of exposed concrete finishes or damage adjacent materials.

END OF SECTION

SECTION 04 01 40.99 - RELOCATION, REUSE, AND RESTORATION OF LATROBE MARBLE COLUMNS

PART 1 - GENERAL

1.1 SUMMARY

A. Description of Work:

1. Remove existing eight Latrobe Ionic marble columns from the Civic Plaza of the existing Supreme Court of Maryland facility, taking them to approved shop for storage and restoration, then relocating four of them in the Large Court of Special Appeals room 4201 in the new Supreme Court of Maryland facility, two in the Small Court of Special Appeals room 4210, and two in the Small Court of Special Appeals room 4215, as indicated on Drawings. Use special care and attention to the means and methods used for dismantling, moving, temporary storage, shop repairs and refinishing, and hoisting the columns into final positions, and for associated repairs in final locations, and for construction and installation work there, and for coordination with adjacent and other work and operations in the new facility, to prevent damage and to ensure lasting installations.

   Clean and repair marble to restore appearance, engineering properties integrity, and finish. Restore and repair spalls, cracks, and disintegrated or otherwise damaged portions of the columns with patching materials colored and patterned to match existing columns marble for areas less than one square inch of visible surface, and with matching marble dutchmen doweled into existing marble for all other areas. Perform this work using approved cleaners and approved repair mortar, crack filler, adhesive and accessory materials as necessary, and finishing dutchmen and other repair surfaces and those of adjacent column marble as necessary, such that dutchmen, and other patches and crack repairs, are not noticeable except possibly on close inspection by knowledgeable building professional.

   Patched and other repaired areas shall match the color and texture of the existing marble once appropriately cleaned, replicating the existing column details and profiles at the repaired areas, and patching and other repairs shall result in a like new appearance. If there are any visible mortar joints, tuckpoint them with mortar tested and approved, to match appearance of existing mortar once cleaned, and to achieve at least existing tensile strength but not to exceed existing compressive strength of existing mortar. Existing non-marble unmolded rectangular bases are to be removed and replaced in new installations with cast stone bases made to match dimensions of those replaced (see 03 45 00 “Precast Architectural Concrete”) and to match columns’ appearance to greatest extent possible. Columns are to be firmly fixed in positions and locations indicated on Drawings. Removed bases are to be disposed of as directed by Owner.

B. Section Includes:

1. Repairing marble columns complete including all labor, materials, tools, equipment and services necessary for and reasonably incidental to complete the cleaning, relocating, repair, restoration and reinstallation of the existing marble columns.

C. Related Requirements:

1. Section 02 41 19 "Selective Demolition" for selective demolition in existing courthouse related to removal of existing historic marble columns.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site or at location where repairs will be completed as approved by Architect.

1. Review schedule, logistics, and methods and procedures related to marble columns dismantling, storage, repair and reinstallation including, but not limited to, the following:

a. Verify stone repair specialist's personnel meet required qualifications requirements, indicate those to perform Project work in shop and those in field, and provide contact information for those responsible for overseeing shop work, field work, and for managing Project and coordinating with General Contractor, Owner and Architect.
b. Verify equipment and facilities needed to make progress and avoid delays.
c. Verify when this work is to occur within in overall Project schedule, including dismantling, transport, shop work and storage, and installation, such that work necessary prior to installation is confirmed will occur adequately prior, that this work will not interfere with other work scheduled to be performed simultaneously or after, and that this work can be performed satisfactorily while maintaining the overall schedule.
d. Review dismantling, transportation, shop work, storage, and installation operations, and review existing and proposed materials, material applications, requirements for submittals, progress documentation and mockups, and requirements for sequencing, tolerances, and required clearances, as well as support required from General Contractor and others at any points throughout work performance, and review requirements for facilities, utilities, environmental conditions, and any other necessities to be provided by others at any points throughout work performance.
e. Review quality-control program, indicate trade point of contact for it, and ensure its coordination with General Contractor’s quality-control program.
f. Review close-out procedures, Project record documents, demonstration and training, and maintenance required or necessary and to be provided or planned for, associated with this work.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
2. Include recommendations for product application and use.
3. Include test data substantiating that products comply with requirements.

B. Shop Drawings:

1. Include dimensioned plans, elevations, sections, and locations of repaired and replaced marble columns and cast stone bases within the facility and their repairs, jointing, and attachments, showing relations with adjoining work.
2. Show partial replacement stone units (dutchmen).
3. Show provisions for any sealant joints or mortar joints.
4. Show provisions for lighting fixtures, conduits, or any other utility or associated facility items as required.
5. Show replacement and repair anchors, including drilled-in pins. Include details of anchors within individual stone units, with locations of anchors and dimensions of holes and recesses in stone required for anchors, including direction and angle of holes for pins.
6. Show locations of scaffolding and points of scaffolding in contact with masonry. Include details of each point of contact or anchorage.

C. Samples for Verification: For the following:

1. Replacement marble. To show full range of color, texture, grain, veining, and finish to be expected. Provide at least two 12-by-12-inch replacement marble Samples, but no fewer than necessary to indicate full range and proportion of variations within range.
2. Each type of patching compound in form of briquettes, at least 3 inches long by 1-1/2 inches wide. Document each Sample with manufacturer and stock number or other information necessary to order additional material.
3. Each type of adhesive.
4. Accessories: Each type of anchor, accessory, and miscellaneous support or other accessory indicated or determined to be necessary.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For stone repair specialist including field supervisors and workers.

B. Marble Column Relocation, Storage, Repair, and Installation Plan.

C. Quality-control program.

1.5 QUALITY ASSURANCE

A. Stone Repair Specialist Qualifications: Engage an experienced stone repair firm to perform work of this Section. Firm shall have completed work similar in material, design, and extent to that indicated for this Project with a record of successful in-service performance. Experience in only installing standard unit masonry or new stone masonry is insufficient experience for stone repair work.

1. Field Supervision: Stone repair specialist firms shall maintain experienced full-time supervisors on Project site during times that stone repair work is in progress.
2. Stone Repair Worker Qualifications: When stone units are being patched, assign at least one worker per crew who is trained and certified by manufacturer of patching compound to apply its products.

B. Marble Column Disassembly, Storage, Repair, Relocation, and Reinstallation Plan: Prepare a written report detailing means and methods for disassembling, moving, storing, repairing, relocating, protecting, hoisting, and reinstalling marble columns including, but not limited to, the following:

1. Disassembly Methodology: A written description of disassembly methods, materials, and equipment proposed for use. Include descriptions of transportation of workers, materials and equipment to and from site from which marble columns are to be removed, and use of scaffolding and/or other items planned for use in accessing columns and performing necessary associated operations. Describe protections of both marble columns being dissembled during disassembly and protections of adjacent areas, and describe daily and final cleaning and demobilization.
2. Shop Operations and Storage: A written description of shop operations and storage facilities, including types and numbers of staff to be engaged in which operations and equipment and materials to be used in such, and environmental conditions to be maintained in shop and in storage, with systems to be used to maintain these conditions.
3. Cleaning Methodology: A written description of cleaning methods, materials, working pressures and equipment proposed for use. Include description of methods for wastewater collection and disposal.
4. Repair Methodology: A written program for each portion of the stone repair work, including prior cleaning and preparation, fine crack repair, larger crack repair, . Describe in detail the materials, methods, and equipment to be used for each portion of the work.
5. Installation Methodology: A written description of installation methods including coordination as required with General Contractor and other subcontractors, utility and related requirements necessary to maintain acceptable environmental conditions and provide adequate power for tools and equipment, lighting, access to potable water as required, scaffolding provision, erection and movement, required associated safety provisions, locations, quantities and protections of stored materials needed in the work performance, sequence of operations in which locations with durations and numbers and types of staff, installation specifics for installation location hoisting, cleaning, patching, finishing, final cleaning and demobilization.

C. Quality-Control Program: Prepare a written quality-control program for this Project to systematically demonstrate the ability of personnel to properly follow methods and use materials and tools without damaging stonework. Include provisions for supervising performance and preventing damage.

D. Mockups: Prepare mockups of stone repair to demonstrate aesthetic effects and to set quality standards for materials and execution and for fabrication and installation.

1. Demonstrate quality of materials, workmanship, and blending with existing work. Include the following as a minimum:

    a. Cleaning: Four square feet or as required to demonstrate effective cleaning materials and techniques.
    b. Crack injection: Apply crack injection in two separate areas as directed.
    c. Patching: Three spalled areas and small holes (at least 1 inch in diameter) as directed.
    d. Partial Stone Replacement: Two partial stone replacements (dutchman repairs).
    e. Other: As required to demonstrate repair techniques and materials to be employed in column restoration.

2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
3. Subject to compliance with requirements, approved mockups may become part of the completed work if undisturbed at time of Substantial Completion.

1.6 STORAGE AND HANDLING

A. Deliver marble columns to construction site soon before hoisting into place. Provide sufficient material protection if stored temporarily, and ensure environmental conditions meet requirements if marble columns will be stored on construction site temporarily.

B. Move, store, and handle stone columns to prevent overstressing, chipping, defacement, and other damage.

C. Store mortar, crack filler, adhesive, and other materials for use in patching and installation in temperature-controlled areas in accordance with product manufacturers' storage requirements and instructions. Follow manufacturer's precautions for handling and disposal.

D. Store adhesives and cleaning chemicals in closed containers in temperature-controlled areas. Follow manufacturer's precautions for handling and disposal.

1.7 FIELD CONDITIONS

A. Temperature Limits, General: In Shop or on construction site or anywhere elsewhere, repair stone units only when air temperature is between 40 and 90 deg F and will remain so for at least seven days after completion of the work unless otherwise indicated. Do not transport stone units or assemblies within seven days of performing repairs on them.

B. For manufactured repair materials, perform work within the environmental limits set by each manufacturer.

PART 2 - PRODUCTS

2.1 STONE MATERIALS

A. Stone Matching Existing: Natural building stone of variety, color, texture, grain, veining, finish, size, and shape that match existing stone and with physical properties as listed below:

1. Physical Properties Marble:

a. Compressive Strength: according to ASTM C170/C170M.
b. Modulus of Rupture: according to ASTM C99/C99M.
c. Absorption: according to ASTM C97/C97M.
d. Bulk Specific Gravity: according to ASTM C97/C97M.

2. For existing stone that exhibits a range of colors, texture, grain, veining, finishes, sizes, or shapes, provide stone that proportionally matches that range rather than stone that matches an individual color, texture, grain, veining, finish, size, or shape within that range.

B. Cutting New Stone: Cut each new stone so that, when it is set in final position, the rift or natural bedding planes will match the rift orientation of existing stones.

2.2 MANUFACTURED CLEANING AND REPAIR MATERIALS

A. Biological Cleaner: Manufacturer's proprietary cleaning formulation intended to remove stains and dirt from surfaces of marble.

1. Basis-of-Design Product: Subject to compliance with requirement, provide **Cathedral Stone Products, Inc.; Bio-Cleaner** or comparable product.
2. pH: 7.0.
3. Specific Gravity: 1.1.
4. Use formulation that is safe for landscaping, plants, and grass.
5. Use formulation that is safe on glass, metals, stone, vinyl, and painted surfaces.

B. Oxidation Remover: Manufacturer's proprietary biodegradable, non-toxic, cleaning formulation intended to remove oxidation stains from surfaces of stone.

1. Basis-of-Design Product: Subject to compliance with requirement, provide **Cathedral Stone Products, Inc.; Oxidation Remover** or comparable product.
2. pH: 2.1.
3. Specific Gravity: 1.2.

C. Marble Repair Mortar: Factory-mixed cementitious product that is custom manufactured for patching stone.

1. Basis-of-Design Product: Subject to compliance with requirements, provide **Cathedral Stone Products, Inc.; Jahn M120 Marble Repair Mortar** or comparable product.
2. Use formulation that is vapor and water permeable (equal to or more than the stone), exhibits low shrinkage, has lower modulus of elasticity than stone units being repaired, and develops high bond strength to all types of stone.
3. Use formulation that contains no latex or acrylic bonding agents or additives.
4. Use formulation having working qualities and retardation control to permit forming and sculpturing where necessary.

D. Casting Mortar: Single-component, mineral based, dry-pack mortar free of any latex or acrylic bonding agents or additives, specially formulated for casting replacement stone pieces that can be custom colored to match the original stone.

1. Basis-of-Design Product: Subject to compliance with requirements, provide **Cathedral Stone Products, Inc.; Jahn M150 Casting Mortar** or comparable product.

E. Cementitious Crack Filler: Ultrafine grout that can be injected into cracks, is suitable for application to wet or dry cracks, exhibits low shrinkage, and develops high bond strength to all types of stone.

1. Basis-of-Design Product: Subject to compliance with requirements, provide **Cathedral Stone Products, Inc.; Jahn M31 Micro Injection Grout, Jahn M32 Micro Injection Grout, and Jahn M40 Crack Injection Grout** or comparable product.

F. Stone-to-Stone Adhesive: Cementitious stone adhesive specifically designed to reattach broken, loose, or spalled stone and recommended in writing by adhesive manufacturer for type of stone repair indicated, and matching stone color.

1. Basis-of-Design Product: Subject to compliance with requirements, provide **Cathedral Stone Products, Inc.; Natural Adhesive** or comparable product.

2.3 ACCESSORY MATERIALS

A. Stone Repair Anchors and Pins: Mechanical fasteners and pins of Type 304 stainless steel; designed for stone stabilization and pinning stone pieces to the extent required.

B. Masking Tape: Nonstaining, nonabsorbent material; compatible with mortar, joint primers, sealants, and surfaces adjacent to joints; and that easily comes off entirely, including adhesive.

C. Other Products: Select materials and methods of use based on the following, subject to approval of a mockup:

1. Previous effectiveness in performing the work involved.
2. Minimal possibility of damaging exposed surfaces.
3. Consistency of each application.
4. Uniformity of the resulting overall appearance.
5. Do not use products or tools that could leave residue on surfaces.

D. If it is determined that a conventional mortar mix is necessary, to restore an existing mortar joint which may be found such as between the capitals and the tops of columns, inform the Architect of the location and characteristics of such joint and mortar such that appropriate materials and processes involving replacement mortar can be determined and so a mortar of appropriate strength matching the appearance of the existing mortar and/or the columns, as determined most appropriate, can be determined. No such mortar joints have been observed and it is assumed that there are none or, if they are, they are of minimal extent. It is also assumed that, if such do exist, the mortar would likely be a whitish color, possibly pigmented and/or containing marble dust, and likely consisting of a mix similar to 1 part portland cement, 1 part lime, and 6 parts sand or mix of sand and marble dust, possibly with less or no portland cement, possibly more lime. If such mortar is necessary, it is to comply with ASTM C270.

PART 3 - EXECUTION

3.1 STONE REPAIR, GENERAL

A. Appearance Standard: Repaired surfaces are to have a uniform appearance as viewed from four (4) feet away by Architect.

B. Apply cleaning and repair materials in conformance with manufacturer’s written instructions.

3.2 PROTECTION

A. Prevent materials and products from staining face of surrounding stone and other surfaces.

1. Cover projecting items of stone and of adjacent materials to protect them from material droppings.
2. Immediately remove material splatters in contact with exposed stone and other surfaces.

3.3 STONE-FRAGMENT REPAIR

A. Where necessary to reinstall and repair piece of stone that has dislodged or to repair missing stone of volume indicated such that new, replacement stone is needed at patch, carefully remove cracked or fallen stone fragment and/or residue in area to be repaired. Reuse only stone fragment that is in sound condition.

B. Remove soil, loose particles, mortar, and other debris or foreign material from fragment or repair stone surfaces to be bonded and from parent stone where fragment had broken off, by cleaning with stiff-fiber brush.

C. Concealed Pinning: Before applying adhesive, prepare for concealed mechanical anchorage consisting of 1/4-inch-diameter, plain stainless-steel pins set into 1/4-inch-diameter holes drilled into parent stone and into, but not through, the fragment. Center and space pins between 3 and 5 inches apart and at least 2 inches from any edge. Insert pins at least 2 inches into parent stone and 2 inches into fragment, unless dimensions do not allow and then as near as possible, but insert no closer than 3/4 inch from exposed face of fragment.

D. Apply stone-to-stone adhesive according to adhesive manufacturer's written instructions. Coat bonding surfaces of fragment or replacement and parent stone, completely filling all crevices and voids.

E. Fit stone fragment or replacement onto parent stone while adhesive is still tacky and hold fragment securely in place until adhesive has cured. Use shims, clamps, wedges, or other devices as necessary to align face of fragment or replacement with face of parent stone.

F. Clean adhesive residue from exposed surfaces and patch chipped areas and exposed drill holes as specified in "Stone Patching" Article.

3.4 STAIN REMOVAL

A. Apply stain removers and cleaners to the stained surface following the manufacturer's instructions for type of stain remover and cleaner appropriate to type of stain and to stone type, for application, dwell time, protection, removal, and rinsing and as determined optimum during mockup preparation.

B. Remove all residue of stain remover from the stone by thoroughly rinsing with clear water.

3.5 CRACK REPAIR

A. General: Comply with cementitious crack-filler manufacturer's written instructions including for application, cleaning before and after use, finished appearance, and engineering integrity of repair.

B. Drill injection ports in locations and at spacing recommended by manufacturer and wash surface and interior of cracks clean.

C. Clean out drill holes and cracks with compressed air and water. Remove dirt and organic matter, loose material, sealants, and failed crack repair materials.

D. Place plastic injection ports in drilled holes and seal face of cracks between injection ports with clay or other nonstaining, removable plugging material. Leave openings at upper ends of cracks for air release.

E. Inject grout into lowest port and continue through ports sequentially, beginning at one end of area and working to opposite end; where possible, begin at lower end of injection area and work upward until it flows freely from all ports. After port has been injected, plug with clay or other suitable material and begin injecting grout at adjacent port, repeating process until all ports have been injected. Seal ports and clean up overflow immediately.

F. Clean injection grout from face of stone before it sets by scrubbing with water.

G. After injection grout has cured remove plugs and repair the ports and crack surface with patching mortar in compliance with cementitious crack-filler manufacturer's written instructions.

3.6 STONE PATCHING

A. Patch the following stone units unless another type of repair or replacement is indicated:

1. Spalled units or those with small holes as indicated.
2. Units with chipped edges or corners.
3. Units with small areas of deep deterioration. Patch deep deteriorations measuring more than 3/4 inch in least dimension and more than 1/4 inch deep.

B. General: Comply with cementitious repair mortar manufacturer's written instructions and those of manufacturers of any other products used.

C. Remove all loose and deteriorated marble from the repair area.

D. Remove deteriorated material and remove adjacent material that has begun to deteriorate. Carefully remove additional material so patch does not have feathered edges but has square or slightly undercut edges on area to be patched and is at least 1/2 inch thick, but not less than recommended in writing by patching compound manufacturer.

E. Remove and replace existing patches unless otherwise indicated or approved by Architect.

F. Moisten substate with clean water.

G. Place patching compound in layers as recommended in writing by patching compound manufacturer, but not less than 1/4 inch or more than 2 inches thick. Roughen surface of each layer to provide a key for next layer if another layer is to follow. Fill repair area with mortar and build up material beyond the surface of the original stone. After initial set, scrape away excess mortar to match original column profile.

1. Simple Details: Trowel, scrape, or carve surface of patch to match texture and surrounding surface plane or contour of the stone. Shape and finish surface before or after curing, to best match existing stone.
2. Carved Details: Build patch up 1/4 inch above surrounding stone, and carve surface to match adjoining stone after patching compound has hardened. Unless otherwise directed in writing by patching compound manufacturer.

H. Keep each layer damp for 72 hours or until patching compound has set, unless otherwise directed in writing by patching compound manufacturer.

I. Cure repair according to manufacturer’s instructions.

J. Remove and replace patches with hairline cracks or that show separation from stone at edges, and those that do not match adjoining stone in color or texture.

3.7 REPLACEMENT PIECES – IF REQUIRED

A. General: Comply with casting mortar manufacturer's written instructions.

B. Construct mold to match profile of replacement piece and coat with non-staining mold release agent.

C. Progressively fill mold with mixed mortar and tamp in place firmly until mold is slightly overfilled. Screed off excess material.

D. Cure according to manufacturer’s instructions.

3.8 INSTALLATION

A. Carefully hoist columns in place and anchor securely at top as indicated on Drawings.

3.9 PROTECTION

A. Protect stone column surfaces, edges, and corners from construction damage. Use securely fastened untreated wood, plywood, or heavy cardboard to prevent damage.

B. Prevent mortar from staining face of surrounding stone and other surfaces.

1. Cover projecting items of this stonework and adjacent work to protect them from mortar droppings.
2. Immediately remove material splatters in contact with exposed stone and other surfaces.

C. Before inspection for Substantial Completion, remove protective coverings and clean surfaces.

3.10 FINAL CLEANING

A. After repair and installation products have fully hardened and set in final locations, thoroughly clean exposed stone surfaces of excess products and foreign matter; use wood scrapers, stiff-nylon or -fiber brushes, and clean water, manually or applied by low-pressure spray if necessary, protecting adjacent work as appropriate.

1. Do not use metal scrapers or brushes.
2. Do not use acidic or alkaline cleaners.

B. Clean mortar, crack filler, adhesive, stone dust and debris from adjacent nonstone surfaces. Use detergent and soft brushes or cloths. Rinse off surfaces as appropriate.

C. Remove masking materials, leaving no residues that could trap dirt.

3.11 FIELD QUALITY CONTROL

A. Architect's Project Representatives: Architect will assign Project representatives to help carry out Architect's responsibilities at the site, including observing progress and quality of portion of the work completed. Allow Architect's Project representatives use of lift devices and scaffolding, as needed, to observe progress and quality of portion of the work completed.

B. Notify Architect's Project representatives in advance of times when lift devices and scaffolding will be relocated. Do not relocate lift devices and scaffolding until Architect's Project representatives have had reasonable opportunity to make inspections and observations of work areas at lift device or scaffold location.

3.12 STONE AND OTHER MATERIALS WASTE DISPOSAL

A. Salvageable Materials: Unless otherwise indicated, excess stone materials are Contractor's property.

B. Stone Waste: Remove stone waste and legally dispose of off Owner's property.

C. Waste from cleaners, patching materials, adhesives, and other materials used in work: Remove waste and legally dispose of off Owner's property.

END OF SECTION

This page is intentionally left blank.

SECTION 04 22 00 - CONCRETE UNIT MASONRY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Concrete masonry units.
2. Mortar and grout.
3. Steel reinforcing bars.
4. Masonry-joint reinforcement.
5. Miscellaneous masonry accessories.

1.2 DEFINITIONS

A. CMU(s): Concrete masonry unit(s).

B. Reinforced Masonry: Masonry containing reinforcing steel in grouted cells.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:

1. Type III Environmental Product Declaration (EPD): For each product.

C. Shop Drawings: For the following:

1. Masonry Units: Show sizes, profiles, coursing, and locations of special shapes.
2. Reinforcing Steel: Detail bending, lap lengths, and placement of unit masonry reinforcing bars. Comply with ACI 315R. Show elevations of reinforced walls.

1.4 INFORMATIONAL SUBMITTALS

A. Material Certificates: For each type and size of the following:

1. Masonry units.

a. Include data on material properties.
b. For masonry units, include data and calculations establishing average net-area compressive strength of units.

2. Cementitious materials. Include name of manufacturer, brand name, and type.
3. Mortar admixtures.

4. Preblended, dry mortar mixes. Include description of type and proportions of ingredients.
5. Grout mixes. Include description of type and proportions of ingredients.
6. Reinforcing bars.
7. Joint reinforcement.
8. Anchors, ties, and metal accessories.

B. Mix Designs: For each type of mortar and grout. Include description of type and proportions of ingredients.

1. Include test reports for mortar mixes required to comply with property specification. Test in accordance with ASTM C109/C109M for compressive strength, ASTM C1506 for water retention, and ASTM C91/C91M for air content.
2. Include test reports, in accordance with ASTM C1019, for grout mixes required to comply with compressive strength requirement.

C. Statement of Compressive Strength of Masonry: For each combination of masonry unit type and mortar type, provide statement of average net-area compressive strength of masonry units, mortar type, and resulting net-area compressive strength of masonry determined in accordance with TMS 602.

D. Cold-Weather and Hot-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with requirements.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.

B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.

C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.

D. Deliver preblended, dry mortar mix in moisture-resistant containers. Store preblended, dry mortar mix in delivery containers on elevated platforms in a dry location or in covered weatherproof dispensing silos.

E. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

1.6 FIELD CONDITIONS

A. Protection of Masonry: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.

1. Extend cover a minimum of 24 inches down both sides of walls, and hold cover securely in place.

B. Do not apply uniform floor or roof loads for at least 12 hours and concentrated loads for at least three days after building masonry walls or columns.

C. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.

1. Protect base of walls from rain-splashed mud and from mortar splatter by spreading coverings on ground and over wall surface.
2. Protect sills, ledges, and projections from mortar droppings.
3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.
4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.

D. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in TMS 602.

1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F and higher and will remain so until masonry has dried, but not less than seven days after completing cleaning.

E. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in TMS 602.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations for Masonry Units: Obtain exposed masonry units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, from single source from single manufacturer for each product required.

B. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from single manufacturer for each cementitious component and from single source or producer for each aggregate.

2.2 PERFORMANCE REQUIREMENTS

A. Provide unit masonry that develops indicated net-area compressive strengths at 28 days.

1. Determine net-area compressive strength of masonry from average net-area compressive strengths of masonry units and mortar types (unit-strength method) in accordance with TMS 602.

2.3 UNIT MASONRY, GENERAL

A. Masonry Standard: Comply with TMS 602 except as modified by requirements in the Contract Documents.

B. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated. Do not use units where such defects are exposed in the completed Work and will be within 20 feet vertically and horizontally of a walking surface.

C. Fire-Resistance Ratings: Comply with requirements for fire-resistance-rated assembly designs indicated.

1. Where fire-resistance-rated construction is indicated, units are listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction.

2.4 CONCRETE MASONRY UNITS

A. Regional Materials: To the extent required to comply with the minimum criteria specified in Section 01 81 13.14 “Sustainable Design Requirements,” verify CMUs are manufactured within 100 miles of Project site from aggregates and cement that have been extracted, harvested, or recovered, as well as manufactured, within 100 miles of Project site.

B. Shapes: Provide shapes indicated and as follows, with exposed surfaces matching exposed faces of adjacent units unless otherwise indicated.

1. Provide special shapes for lintels, corners, jambs, sashes, movement joints, headers, bonding, and other special conditions.
2. Provide square-edged units for outside corners unless otherwise indicated.

C. CMUs: ASTM C90.

1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 2000 psi.
2. Density Classification: Normal weight.
3. Size (Width): Manufactured to dimensions 3/8 inch less-than-nominal dimensions.

2.5 CONCRETE LINTELS

A. General: Provide one of the following:

B. Precast Concrete Lintels Matching CMU in Color, Texture: ASTM C1623, matching density classification; and with reinforcing bars indicated. Provide lintels with net-area compressive strength not less than that of CMUs.

2.6 MORTAR AND GROUT MATERIALS

A. Regional Materials: Manufacture aggregate for mortar and grout, cement, and lime within 100 miles of Project site from materials that have been extracted, harvested, or recovered, as well as manufactured, within 100 miles of Project site.

B. Portland Cement: ASTM C150/C150M, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.

C. Hydrated Lime: ASTM C207, Type S.

D. Portland Cement-Lime Mix: Packaged blend of portland cement and hydrated lime containing no other ingredients.

E. Aggregate for Mortar: ASTM C144.

1. For mortar that is exposed to view, use washed aggregate consisting of natural sand or crushed stone.
2. For joints less than 1/4 inch thick, use aggregate graded with 100 percent passing the No. 16 sieve.
3. White-Mortar Aggregates: Natural white sand or crushed white stone.
4. Colored-Mortar Aggregates: Natural sand or crushed stone of color necessary to produce required mortar color.

F. Aggregate for Grout: ASTM C404.

G. Cold-Weather Admixture: Nonchloride, noncorrosive, accelerating admixture complying with ASTM C494/C494M, Type C, and recommended by manufacturer for use in masonry mortar of composition indicated.

H. Water: Potable.

2.7 REINFORCEMENT

A. Uncoated Steel Reinforcing Bars: ASTM A615/A615M or ASTM A996/A996M, Grade 60.

B. Reinforcing Bar Positioners: Wire units designed to fit into mortar bed joints spanning masonry unit cells and to hold reinforcing bars in center of cells. Units are formed from 0.148-inch steel wire, hot-dip galvanized after fabrication. Provide units designed for number of bars indicated.

C. Masonry-Joint Reinforcement, General: Truss type complying with ASTM A951/A951M.

1. Interior Walls: Hot-dip galvanized carbon steel.
2. Wire Size for Side Rods: 0.148-inch diameter.
3. Wire Size for Cross Rods: 0.148-inch diameter.
4. Provide in lengths of not less than 10 feet, with prefabricated corner and tee units.

2.8 TIES AND ANCHORS

A. General: Ties and anchors extend at least 1-1/2 inches into masonry but with at least a 5/8-inch cover on outside face.

B. Materials: Provide ties and anchors specified in this article that are made from materials that comply with the following unless otherwise indicated:

1. Hot-Dip Galvanized, Carbon-Steel Wire: ASTM A82/A82M, with ASTM A153/A153M, Class B-2 coating.
2. Galvanized-Steel Sheet: ASTM A653/A653M, Commercial Steel, G60 zinc coating.
3. Steel Plates, Shapes, and Bars: ASTM A36/A36M.

C. Adjustable Anchors for Connecting to Structural Steel Framing: Provide anchors that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall.

1. Anchor Section for Welding to Steel Frame: Crimped 1/4-inch-diameter, hot-dip galvanized steel wire.
2. Tie Section: Triangular-shaped wire tie made from 0.187-inch-diameter, hot-dip galvanized steel wire.

D. Adjustable Anchors for Connecting to Concrete: Provide anchors that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall.

1. Connector Section: Dovetail tabs for inserting into dovetail slots in concrete and attached to tie section; formed from 0.105-inch-thick steel sheet, galvanized after fabrication.

a. 0.108-inch-thick, galvanized-steel sheet may be used at interior walls unless otherwise indicated.

2. Tie Section: Triangular-shaped wire tie made from 0.187-inch-diameter, hot-dip galvanized steel wire.

E. Partition Top Anchors: 0.105-inch-thick metal plate with a 3/8-inch-diameter metal rod 6 inches long welded to plate and with closed-end plastic tube fitted over rod that allows rod to move in and out of tube. Fabricate from steel, hot-dip galvanized after fabrication.

2.9 MISCELLANEOUS MASONRY ACCESSORIES

A. Compressible Filler: Premolded filler strips complying with ASTM D1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene, urethane, or PVC.

B. Preformed Control-Joint Gaskets: Made from styrene-butadiene-rubber compound, complying with ASTM D2000, Designation M2AA-805 or PVC, complying with ASTM D2287, Type PVC-65406 and designed to fit standard sash block and to maintain lateral stability in masonry wall; size and configuration as indicated.

C. Bond-Breaker Strips: Asphalt-saturated felt complying with ASTM D226/D226M, Type I (No. 15 asphalt felt).

2.10 MORTAR AND GROUT MIXES

A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures unless otherwise indicated.

1. Do not use calcium chloride in mortar or grout.

2. Use portland cement-lime mortar unless otherwise indicated.
3. Add cold-weather admixture (if used) at same rate for all mortar that will be exposed to view, regardless of weather conditions, to ensure that mortar color is consistent.

B. Preblended, Dry Mortar Mix: Furnish dry mortar ingredients in form of a preblended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.

C. Mortar for Unit Masonry: Comply with ASTM C270, Type S.

D. Grout for Unit Masonry: Comply with ASTM C476.

1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with TMS 602 for dimensions of grout spaces and pour height.
2. Proportion grout in accordance with ASTM C476, paragraph 4.2.2 for specified 28-day compressive strength indicated, but not less than 3000 psi.
3. Provide grout with a slump of 10 to 11 inches as measured in accordance with ASTM C143/C143M.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
2. Verify that foundations are within tolerances specified.
3. Verify that reinforcing dowels are properly placed.
4. Verify that substrates are free of substances that would impair mortar bond.

B. Before installation, examine rough-in and built-in construction for piping systems to verify actual locations of piping.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Build chases and recesses to accommodate items specified in this and other Sections.

B. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match construction immediately adjacent to opening.

C. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.

3.3 TOLERANCES

A. Dimensions and Locations of Elements:

1. For dimensions in cross section or elevation, do not vary by more than plus 1/2 inch or minus 1/4 inch.
2. For location of elements in plan, do not vary from that indicated by more than plus or minus 1/2 inch.
3. For location of elements in elevation, do not vary from that indicated by more than plus or minus 1/4 inch in a story height or 1/2 inch total.

B. Lines and Levels:

1. For bed joints and top surfaces of bearing walls, do not vary from level by more than 1/4 inch in 10 feet, or 1/2-inch maximum.
2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2-inch maximum.
3. For vertical lines and surfaces do not vary from plumb by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2-inch maximum.
4. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2-inch maximum.
5. For lines and surfaces, do not vary from straight by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2-inch maximum.
6. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4 inch in 10 feet, or 1/2-inch maximum.
7. For faces of adjacent exposed masonry units, do not vary from flush alignment by more than 1/16 inch.

C. Joints:

1. For bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch, with a maximum thickness limited to 1/2 inch.
2. For exposed bed joints, do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch.
3. For head and collar joints, do not vary from thickness indicated by more than plus 3/8 inch or minus 1/4 inch.
4. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch.

3.4 LAYING MASONRY WALLS

A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.

B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in running bond; do not use units with less-than-nominal 4-inch horizontal face dimensions at corners or jambs.

C. Lay concealed masonry with all units in a wythe in running bond. Bond and interlock each course of each wythe at corners. Do not use units with less-than-nominal 4-inch horizontal face dimensions at corners or jambs.

D. Stopping and Resuming Work: Stop work by stepping back units in each course from those in course below; do not tooth. When resuming work, clean masonry surfaces that are to receive mortar, remove loose masonry units and mortar, and wet brick if required before laying fresh masonry.

E. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.

F. Fill space between steel frames and masonry solidly with mortar unless otherwise indicated.

G. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath, wire mesh, or plastic mesh in the joint below, and rod mortar or grout into core.

H. Fill cores in hollow CMUs with grout 24 inches under bearing plates, beams, lintels, posts, and similar items unless otherwise indicated.

I. Build nonload-bearing interior partitions full height of story to underside of solid floor or roof structure above unless otherwise indicated.

1. Terminate top of wall as indicated on Drawings.
2. At fire-rated partitions, treat joint between top of partition and underside of structure above to comply with Section 078443 "Joint Firestopping."

3.5 MORTAR BEDDING AND JOINTING

A. Lay hollow CMUs as follows:

1. Bed face shells in mortar and make head joints of depth equal to bed joints.
2. Bed webs in mortar in all courses of piers, columns, and pilasters.
3. Bed webs in mortar in grouted masonry, including starting course on footings.
4. Fully bed entire units, including areas under cells, at starting course on footings where cells are not grouted.

B. Lay solid CMUs with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.

C. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.

D. Cut joints flush for masonry walls to receive plaster or other direct-applied finishes (other than paint) unless otherwise indicated.

E. Cut joints flush where indicated to receive waterproofing unless otherwise indicated.

3.6 MASONRY-JOINT REINFORCEMENT

A. General: Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8 inch on exterior side of walls, 1/2 inch elsewhere. Lap reinforcement a minimum of 6 inches.

1. Space reinforcement not more than 16 inches o.c.
2. Provide reinforcement not more than 8 inches above and below wall openings and extending 12 inches beyond openings in addition to continuous reinforcement.

B. Interrupt joint reinforcement at control and expansion joints unless otherwise indicated.

C. Provide continuity at wall intersections by using prefabricated T-shaped units.

D. Provide continuity at corners by using prefabricated L-shaped units.

3.7 ANCHORING MASONRY TO STRUCTURAL STEEL AND CONCRETE

A. Anchor masonry to structural steel and concrete, where masonry abuts or faces structural steel or concrete, to comply with the following:

1. Provide an open space not less than 1/2 inch wide between masonry and structural steel or concrete unless otherwise indicated. Keep open space free of mortar and other rigid materials.
2. Anchor masonry with anchors embedded in masonry joints and attached to structure.
3. Space anchors as indicated, but not more than 24 inches o.c. vertically and 36 inches o.c. horizontally.

3.8 CONTROL AND EXPANSION JOINTS

A. General: Install control- and expansion-joint materials in unit masonry as masonry progresses. Do not allow materials to span control and expansion joints without provision to allow for in-plane wall or partition movement.

B. Form control joints in concrete masonry using one of the following methods:

1. Fit bond-breaker strips into hollow contour in ends of CMUs on one side of control joint. Fill resultant core with grout, and rake out joints in exposed faces for application of sealant.
2. Install preformed control-joint gaskets designed to fit standard sash block.
3. Install interlocking units designed for control joints. Install bond-breaker strips at joint. Keep head joints free and clear of mortar, or rake out joint for application of sealant.
4. Install temporary foam-plastic filler in head joints, and remove filler when unit masonry is complete for application of sealant.

3.9 LINTELS

A. Provide lintels where shown and where openings of more than 12 inches for brick-size units and 24 inches for block-size units are shown without structural steel or other supporting lintels.

B. Provide minimum bearing of 8 inches at each jamb unless otherwise indicated.

3.10 REINFORCED UNIT MASONRY

A. Temporary Formwork and Shores: Construct formwork and shores as needed to support reinforced masonry elements during construction.

1. Construct formwork to provide shape, line, and dimensions of completed masonry as indicated. Make forms sufficiently tight to prevent leakage of mortar and grout. Brace, tie, and support forms to maintain position and shape during construction and curing of reinforced masonry.
2. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and other loads that may be placed on them during construction.

B. Placing Reinforcement: Comply with requirements in TMS 602.

C. Grouting: Do not place grout until entire height of masonry to be grouted has attained enough strength to resist grout pressure.

1. Comply with requirements in TMS 602 for cleanouts and for grout placement, including minimum grout space and maximum pour height.
2. Limit height of vertical grout pours to not more than 60 inches.

3.11 FIELD QUALITY CONTROL

A. Testing and Inspecting: Owner will engage special inspectors to perform tests and inspections and prepare reports. Allow inspectors access to scaffolding and work areas as needed to perform tests and inspections. Retesting of materials that fail to comply with specified requirements is done at Contractor's expense.

3.12 REPAIRING, POINTING, AND CLEANING

A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.

B. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application, where indicated.

C. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.

D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:

1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
2. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.

3. Protect adjacent stone and nonmasonry surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
4. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
5. Clean concrete masonry by applicable cleaning methods indicated in NCMA TEK 8-4A.

3.13 MASONRY WASTE DISPOSAL

A. Salvageable Materials: Unless otherwise indicated, excess masonry materials are Contractor's property. At completion of unit masonry work, remove from Project site.

B. Masonry Waste Recycling: Return broken CMUs not used as fill to manufacturer for recycling.

C. Excess Masonry Waste: Remove excess clean masonry waste that cannot be recycled, and other masonry waste, and legally dispose of off Owner's property.

END OF SECTION

SECTION 05 0 519 – POST-INSTALLED ANCHORS

PART 1 - GENERAL

1.1 DEFINITIONS

A. "Anchor" includes steel elements post-installed into hardened concrete, concrete masonry, or brick and used to transmit applied loads.

B. Mechanical Anchors: “Expansion”, “Wedge”, or “Screw” Anchors which mechanically anchor themselves in the base material using friction and some type of movement within the mechanical anchor to achieve holding values, and manufacturer’s printed installation instructions (MPII). Type and size as indicated on Drawings. Drawing reference to “expansion bolt” or “wedge or screw anchors” indicates use of this anchor type as specified by this paragraph.

C. Adhesive Anchors: “Adhesive” and “Epoxy” Anchors, or “Cartridge Injection Adhesive Anchors” consisting of threaded steel rod, inserts or reinforcing dowels, complete with nuts, washers, polymer or hybrid mortar adhesive injection system, and manufacturer’s printed installation instructions (MPII). Type and size as indicated on Drawings. Drawing reference to “adhesive” associated with drilled rebar or “epoxy adhesive” indicates use of this anchor type as specified by this paragraph.

1.2 SUMMARY

A. Section includes requirements for all anchors that are post-installed into hardened concrete, concrete masonry, or brick. This guide specification does not cover through bolts, powder or pneumatic actuated nails, or cast in anchors.

B. Related Requirements:

1. Section 03 30 00 "Cast-in-place concrete" for cast-in place embedded items.
2. Section 04 12 00 “Concrete Unit Masonry”
3. Section 05 12 00 “Structural Steel Framing” for grout.
4. Division 8 for curtain wall support.
5. Division 22, 23, and 26 Hangers and Supports Sections.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product. Product specifications shall include recommended design values and physical characteristics for epoxy dowels, expansion, and mechanical anchors.

B. Post-Installed Anchor Product Data: Submit data for proprietary materials, ICC-ES reports, manufacturer’s specifications (including finishes and/or materials), and Material Safety Data Sheets (MSDS).

1. Submittals shall clearly indicate where each anchor type and diameter is intended to be used.

2. ICC-ES listings and performance data shall include recommended loading for each application.
3. ICC-ES certificates shall be valid for the design code of the project.
4. Products other than “Basis of Design Anchors:”

    a. Only manufacturers with an ICC-ES or IAPMO-UES listing will be considered for substitution requests.
    b. The contractor shall submit, for Engineer-of-Record’s review, calculations that are prepared & sealed by a registered Professional Engineer demonstrating that the substituted product is capable of achieving the pertinent equivalent performance values of the specified product using the appropriate design procedure and/or standard(s) as required by the Building Code.
    c. In addition, the calculations shall specify the diameter and embedment depth of the substituted product.
    d. Any increase in material costs for such submittal shall be the responsibility of the contractor.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.

B. Installer Qualifications & Procedures: Submit a letter of procedure stating method of drilling, the product proposed for use, the complete installation procedure, manufacturer training date, and a list of the personnel to be trained on anchor installation.

1. Submit certification for each worker showing that they have completed the above training within three years prior to onsite work. Certification must include organization or manufacturer's name, instructor's name and qualifications, trainee's name, list of instruction received, date of instruction, and confirmation of successful performance tests.

C. Manufacturer’s printed installation instructions (MPII).

D. Field quality-control reports.

E. Closeout Submittals: Submit the following:

1. Record Documents: Project record documents for installed materials.

1.5 QUALITY ASSURANCE

A. Post-Installed Anchor Installer Qualifications: Post-installed anchors shall be installed by a qualified contractor/installer with at least three years of experience performing similar installations. Experience shall include installing anchors equal to type and into the substrate material required for this project. Installers shall undergo training as follows:

1. Installer training: Conduct a thorough training with the manufacturer or the manufacturer’s representative for the contractor/installer. Training to consist of a review of the complete installation process for drilled-in anchors, to include but not limited to:

    a. Hole drilling procedure
    b. Hole preparation and cleaning technique

c. Adhesive Injection & dispenser training and maintenance
d. Rebar dowel preparation and installation
e. Proof loading/torquing
f. Installation in horizontal and upward orientation

B. Installation of adhesive anchors horizontally or upwardly inclined to support sustained tension loads shall be performed by personnel certified by an applicable certification program. Certification shall include written and performance tests in accordance with the ACI/CRSI Adhesive Anchor Installer Certification program, or equivalent.

C. Installation of adhesive anchors shall only be performed by personnel trained to install adhesive anchors. Installation of anchors shall be in accordance with the Manufacturer's Printed Installation Instructions (MPII).

D. Certifications: Anchors shall have the following certification: ICC ES Evaluation Report indicating compliance with ICC ES Acceptance Criteria applicable for the governing building code.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver to job site in manufacturer's or distributor's packing undamaged, complete with installation instructions. Store anchors and adhesives in accordance with manufacturer's recommendations.

B. Protect, store, and handle materials in accordance with manufacturer's recommendations to prevent damage or deterioration. Do not allow chemical materials to freeze. Remove materials that have not be stored in accordance with the manufacturer's recommendations, including expired materials, from the job site.

1.7 PROJECT CONDITIONS

A. Adhesive anchors shall be installed in concrete having a minimum age of 21 days at the time of anchor installation.

B. Anchoring adhesives must be stored at temperatures prescribed by the manufacturer.

C. Anchoring adhesives must not be used beyond the expiration date.

D. The anchor or fastener coating, plating, or steel type must provide suitable corrosion resistance for the environment for which the anchor or fastener is installed.

1.8 BASIS OF DESIGN ANCHORS

A. The Basis of Design anchor designated on the Drawings has been selected based on the required design load capacity as compared to the Manufacturer's specific allowable load capacity for that specific product. Drawings indicate type of anchor, size and length of embedment based on the specific product indicated. Refer to Division 01 "Product Requirements." Comparable products shall be submitted for review and approval by the engineer prior to installation.

PART 2 - PRODUCTS

2.1 FASTENERS AND ANCHORS:

A. Bolts and Studs: ASTM A307; ASTM A449 where “high strength” is indicated on the Drawings.

B. Carbon and Alloy Steel Nuts: ASTM A563.

C. Carbon Steel Washers: ASTM F436.

D. Carbon Steel Threaded Rod: ASTM F1554 Grade 36, unless higher Grade is indicated on Drawings.

E. Wedge Anchors: ASTM A510; or ASTM A108.

F. Stainless Steel Bolts, Hex Cap Screws, and Studs: ASTM F593.

G. Stainless Steel Nuts: ASTM F594.

H. Zinc Plating: ASTM B633.

I. Hot-Dip Galvanizing: ASTM A153.

J. Reinforcing Dowels: ASTM A615

2.2 ADHESIVE ANCHOR SYSTEMS

A. Adhesive to bond steel anchors to concrete. The adhesive must be a moisture insensitive, structural adhesive. Anchors must have been tested and qualified for performance in cracked and uncracked concrete, horizontal and overhead applications, and long term creep.

2.3 DRILLED-IN ANCHORS FOR CONCRETE

A. Anchors selected shall be ICC-ES approved for cracked concrete of minimum strength indicated on drawings. Only anchors with ICBO/ICC approval are approved for use.

B. Wedge anchors: Wedge type, torque-controlled, with impact section to prevent thread damage complete with required nuts and washers. Provide anchors with length identification markings conforming to ICC ES AC01 or ICC ES AC193. Type and size as indicated on Drawings.

1. Interior use: Unless otherwise indicated on the Drawings, provide carbon steel anchors with zinc plating in accordance with ASTM B633, Type III Fe/Zn 5 (SC1).
2. Exterior Use: Provide stainless steel anchors. Stainless steel anchors shall be AISI Type 304 stainless steel provided with stainless steel nuts and washers of matching alloy group and minimum proof stress equal to or greater than the specified minimum full-size tensile strength of the externally threaded fastener. Stainless steel nuts shall conform to ASTM F594 unless otherwise specified. Avoid installing stainless steel anchors in contact with galvanically dissimilar metals. “Exterior” use conditions include but are not limited to the following:

a. Exterior Exposed Conditions.
b. Interior spaces that are not conditioned (heated or cooled).
c. Potentially Wet Environments.
d. Attachment of Exterior Cladding Materials

3. Where anchor manufacturer is not indicated, subject to compliance with requirements and acceptance by the Engineer, provide the following:

a. Hilti Kwik Bolt TZ2 (ICC-ES ESR-4266), carbon steel and AISI Type 304 Stainless Steel.
b. SIMPSON Strong-Tie Strong-Bolt 2 Wedge Anchor (ICC-ES ESR-3037), carbon steel or type 316 or 304 stainless steel
c. DeWALT/POWERS – "Power-Stud + SD1" (ICC-ES ESR-2818)
d. DeWALT/POWERS – "Power Stud + SD2" (ICC-ES ESR-2502)
e. ITW/Redhead – Trubolt+ Wedge Anchor (ICC-ES ESR-3772)

C. Screw Anchors: Screw type. Pre-drilling of the hole requires a standard ANSI drill bit with the same diameter as the anchor and installing the anchor will be done with an impact wrench. Provide anchors with a diameter and anchor length marking on the head. Type and size as indicated on Drawings.

1. Interior Use: Unless otherwise indicated on the Drawings, provide carbon steel anchors with zinc plating equivalent to DIN EN ISO 4042 (8μm min.).
2. Where anchor manufacturer is not indicated, subject to compliance with requirements and acceptance by the Engineer, provide the following:

a. Hilti KH-EZ (ICC-ES ESR-3027).
b. Hilti Kwik-HUS EZ-I (ICC-ES ESR-3027).
c. Hilti Kwik-HUS (ICC-ES ESR-3027).
d. Simpson Strong-Tie Titen HD Screw Anchor (ICC-ES ESR-2713).
e. ITW Red Head Buildex Tapcon Screw Anchor (ICC-ES ESR-2202).

D. Cartridge Injection Adhesive Anchors: Threaded steel rod, inserts or reinforcing dowels, complete with nuts, washers, polymer or hybrid mortar adhesive injection system, and manufacturer's installation instructions. Type and size as indicated on Drawings. Drawing reference to "adhesive" associated with drilled rebar or "adhesive anchors" indicates use of this anchor type as specified by this paragraph.

1. Interior Use: Unless otherwise indicated on the Drawings, provide carbon steel threaded rods conforming to ASTM A36, ASTM A 193 Type B7 or ISO 898 Class 5.8 with zinc plating in accordance with ASTM B633, Type III Fe/Zn 5 (SC1) or carbon steel HIT TZ rods conforming to ASTM A510 with chemical composition of AISI 1038.
2. Exterior Use: Provide stainless steel anchors. Stainless steel anchors shall be AISI Type 304 stainless steel provided with stainless steel nuts and washers of matching alloy group and minimum proof stress equal to or greater than the specified minimum full-size tensile strength of the externally threaded fastener. All nuts shall conform to ASTM F594 unless otherwise specified. Avoid installing stainless steel anchors in contact with galvanically dissimilar metals. "Exterior" use conditions include but are not limited to the following:

a. Exterior Exposed Conditions.
b. Interior spaces that are not conditioned (heated or cooled).
c. Potentially Wet Environments.
d. Attachment of Exterior Cladding Materials

3. Reinforcing dowels shall be ASTM A615 Grade 60.
4. Where anchor manufacturer is not indicated, subject to compliance with requirements and acceptance by the Engineer, provide the following:

    a. Hilti HAS threaded rods with HIT-HY 200V3 Safe Set System using Hilti Hollow Drill Bit and VC 20/40 vacuum System for anchor and rebar anchorage to concrete (ICC-ES ESR-4868).
    b. Hilti HIT-Z anchor rods with HIT-HY 200 Safe Set System for anchorage to concrete (ICC-ES ESR-3187).
    c. Hilti HAS threaded rods with HIT-RE 500 V3 Safe Set System using Hilti Hollow Drill Bit and VC 20/40 vacuum System for anchor and rebar anchorage to concrete (ICC-ES ESR-3814).
    d. SIMPSON Strong-Tie Anchor Systems – “SET-XP Epoxy Adhesive Anchors”, ICC-ES ESR-2508
    e. DeWALT/POWERS – AC 100+ GOLD (ICC-ES ESR-2582)
    f. ITW Red Head – Epcon C6+ Adhesive Anchoring System (ICC-ES ESR-4046)

2.4 DRILLED-IN ANCHORS FOR MASONRY

A. Wedge anchors: Wedge type, torque-controlled, with impact section to prevent thread damage complete with required nuts and washers. Provide anchors with length identification markings conforming to ICC ES AC01 or ICC ES AC193. Type and size as indicated on Drawings.

1. Wedge type anchors are permissible at solid grouted masonry only. The Contractor shall ensure that the cores are grouted solid for a minimum 3 cells at locations where post installed anchors are required in solid grouted masonry. Contractor shall coordinate with all trades.
2. Interior use: Unless otherwise indicated on the Drawings, provide carbon steel anchors with zinc plating in accordance with ASTM B633, Type III Fe/Zn 5 (SC1).
3. Exterior Use: Provide stainless steel anchors. Stainless steel anchors shall be AISI Type 304 stainless steel provided with stainless steel nuts and washers of matching alloy group and minimum proof stress equal to or greater than the specified minimum full-size tensile strength of the externally threaded fastener. Stainless steel nuts shall conform to ASTM F594 unless otherwise specified. Avoid installing stainless steel anchors in contact with galvanically dissimilar metals. “Exterior” use conditions include but are not limited to the following:

    a. Exterior Exposed Conditions.
    b. Interior spaces that are not conditioned (heated or cooled).
    c. Potentially Wet Environments.
    d. Attachment of Exterior Cladding Materials

4. Where anchor manufacturer is not indicated, subject to compliance with requirements and acceptance by the Engineer, provide the following:

    a. Hilti Kwik Bolt TZ2 Masonry Anchor (ICC-ES ESR 4561)
    b. Simpson Strong-Tie Wedge-All Anchor (ICC-ES ESR-1396)
    c. DeWALT/POWERS Power-Stud+SD1 (ICC-ES ESR 2966)

B. Cartridge Injection Adhesive Anchors: Threaded steel rod, inserts or reinforcing dowels, complete with nuts, washers, polymer or hybrid mortar adhesive injection system, and manufacturer’s installation instructions. Type and size as indicated on Drawings.

1. Adhesive type anchors are permissible at both solid grouted and hollow masonry.
2. Interior Use: Unless otherwise indicated on the Drawings, provide carbon steel threaded rods with zinc plating in accordance with ASTM B633, Type III Fe/Zn 5 (SC1) or carbon steel HIT TZ rods conforming to ASTM A510 with chemical composition of AISI 1038.
3. Exterior Use: Provide stainless steel anchors. Stainless steel anchors shall be AISI Type 304 stainless steel provided with stainless steel nuts and washers of matching alloy group and minimum proof stress equal to or greater than the specified minimum full-size tensile strength of the externally threaded fastener. All nuts shall conform to ASTM F594 unless otherwise specified. Avoid installing stainless steel anchors in contact with galvanically dissimilar metals. “Exterior” use conditions include but are not limited to the following:

    a. Exterior Exposed Conditions.
    b. Interior spaces that are not conditioned (heated or cooled).
    c. Potentially Wet Environments.
    d. Attachment of Exterior Cladding Materials

4. Reinforcing dowels shall be ASTM A615 Grade 60.
5. Where anchor manufacturer is not indicated, subject to compliance with requirements and acceptance by the Engineer, provide the following:

    a. Solid Grouted Masonry:

        1) Hilti HIT-HY 270 Masonry Adhesive Anchoring System. (ICC-ES ESR 4143)

            a) Steel rod element shall all-threaded steel rod, steel reinforcing bars, or Hilti HIS steel internally threaded inserts

        2) Simpson Strong-Tie SET-XP Epoxy Adhesive (UES ER 0265)
        3) DeWALT/POWERS AC 100+ Gold (ICC-ES ESR 4105)

    b. Hollow/Multi-Wythe Masonry:

        1) Hilti HIT-HY 270 Masonry Adhesive Anchoring System. (ICC-ES ESR 4143)

            a) Steel rod element shall be all-threaded steel rods, Hilti HIT-IC internally threaded inserts, and Hilti HIT-SC plastic mesh screen tubes. The appropriate size screen shall be used per the adhesive manufacturer’s recommendation.

        2) Simpson Strong-Tie ET-HP Adhesive Anchor System (ICC-ES ESR 3638)

            a) Steel rod element shall be all-threaded steel rods with plastic or steel mesh screen tubes. The appropriate size screen, dispensers and hole cleaning equipment shall be used per the adhesive manufacturer’s recommendation.

        3) DeWALT/POWERS AC 100+ Gold (ICC-ES ESR 3200)

            a) Steel rod element shall be continuously threaded steel rods with stainless steel mesh screen tubes. The appropriate size screen, static mixing nozzles, dispensing tools and hole cleaning equipment shall be used per the adhesive manufacturer’s recommendation.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Anchoring and Reinforcing

1. Install anchors in accordance with the spacing and edge clearances indicated on the drawings. Anchor capacity is also highly dependent on proper installation. Follow all manufacturer and Evaluation Report installation instructions.
2. Drill holes for anchors using drilling equipment and bits suitable for the intended purpose, in accordance with Manufacturer's Published Installation Instructions. Drill bits shall be of diameters as specified by the anchor manufacturer. Unless otherwise shown on the Drawings, all holes shall be drilled perpendicular to the concrete surface. Deviations more than 6 degrees from perpendicular are not acceptable.

B. Embedded Items:

1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors.
2. Create a template at each anchor connection location prior to fabricating holes in connection plates. Template must be made by locating existing reinforcing with an approved reinforcement detection system.

    a. The contractor must review the project drawings to accurately locate the position of reinforcing bars and embedded items at the locations of the anchors in the field.

3. Exercise care in coring or drilling to avoid damaging existing reinforcing or embedded items. Notify the Engineer if reinforcing steel or other embedded items are encountered during drilling. Take precautions as necessary to avoid damaging prestressing tendons, electrical and telecommunications conduit, and gas lines.

C. Drilling and Installing Adhesive Anchors:

1. Cartridge Injection Adhesive Anchors: Clean all holes per manufacturer instructions to remove loose material and drilling dust prior to installation of adhesive. Inject adhesive into holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive. Follow manufacturer recommendations to ensure proper mixing of adhesive components. Sufficient adhesive shall be injected in the hole to ensure that the annular gap is filled to the surface. Remove excess adhesive from the surface. Shim anchors with suitable device to center the anchor in the hole. Do not disturb or load anchors before manufacturer specified cure time has elapsed.
2. Base Material Strength: Unless otherwise specified, do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength. Adhesive anchors must not be installed in concrete that is less than 21 days old.
3. Observe manufacturer recommendations with respect to installation temperatures for cartridge injection adhesive anchors and capsule anchors. Adhesives must not be used beyond the expiration date.
4. Do not disturb or load anchor before manufacturer's specified curing time.

D. Drilling and Installing Mechanical Anchors:

a. Clean holes, install anchors and set anchors in place in accordance with the manufacturer's recommendations. Cored Holes: Where anchors are permitted to be installed in cored holes, use core bits with matched tolerances as specified by the manufacturer. Properly clean cored hole per manufacturer's instructions.
b. Base Material Strength: Unless otherwise specified, do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength. Mechanical anchors must not be installed in concrete that is less than 7 days old.

2. Perform anchor installation in accordance with manufacturer instructions.
3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in part to be fastened. Set anchors to manufacturer's recommended torque, using a torque wrench. Following attainment of 10% of the specified torque, 100% of the specified torque shall be reached within 7 or fewer complete turns of the nut. If the specified torque is not achieved within the required number of turns, the anchor shall be removed and re-placed unless otherwise directed by the Engineer.

3.2 REPAIR OF DEFECTIVE WORK

A. Remove and replace misplaced or malfunctioning anchors. Fill empty anchor holes and patch failed anchor locations with high-strength non-shrink, nonmetallic grout. Anchors that fail to meet proof load or installation torque requirements shall be regarded as malfunctioning.

B. Any holes made for anchors that are not used must be filled with non-shrink, non-metallic grout suitable for the orientation and size of hole and have a minimum compressive strength of 4000 psi. Repair must completely fill hole and be flush with existing concrete or masonry. Place in accordance with manufacturer's recommended instructions. Final anchor positions from repair patches must not be within 1 inch or as recommended by manufacturer, whichever is greater.

3.3 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a special inspector and qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.

1. Adhesive anchors installed in horizontal or upwardly inclined orientations to resist sustained tension loads shall be continuously inspected during installation by an inspector specially approved for that purpose by the building official.

B. Definitions:

1. Special inspection: Inspection of construction requiring the expertise of an approved special inspector in order to ensure compliance with IBC and the approved construction documents performed by qualified special inspectors. Special Inspection, continuous or periodic, of post-installed anchors, shall be provided as required by ICC-ES or IAPMO-UES evaluation reports and/or as specified by the Engineer of Record. This service shall be performed by personnel independent of the manufacturer or contractor so as to prevent a conflict of interest.
2. Continuous special inspection: Special inspection by the special inspector who is continuously present when and where the work for be inspected is being performed.
3. Periodic special inspection: Special inspection by the special inspector who is intermittently present where the work to be inspected has been or is being performed.

C. Special Inspections for Post-Installed Adhesive Anchors

1. As a minimum, the special inspector shall provide periodic special inspection for the following items, except provide continuous special inspection where adhesive anchors are used to resist sustained tension in horizontal or upwardly inclined orientations, or where the findings of the Evaluation Report for the adhesive anchor product require it:

    a. Hole drilling method in accordance with the MPII.

        1) Verify initial installations of each type and size of adhesive anchor by construction personnel on site, including examination of drill bits and hole sizes.
        2) Subsequent installations of the same anchor type and size by the same construction personnel shall be permitted to be performed in the absence of the special inspector.
        3) Any change in the anchor product being installed or the personnel performing the installation shall require an initial inspection.
        4) For ongoing installations installed over an extended period, the special inspector shall make regular inspections to confirm correct hole drilling procedures are followed.

2. As a minimum, the special inspector shall provide continuous special inspection for the following items:

    a. Anchor edge distance and spacing.
    b. Hole diameter and depth.
    c. Hole cleaning in accordance with the MPII.
    d. Anchor element type, material, diameter, and length.
    e. Adhesive identification and expiration date.
    f. Adhesive installation in accordance with the MPII

3. Special Inspector must perform proof loading.

    a. Perform proof loading on the first three anchors of each type and size, for each installer, for anchors installed at either elevated temperatures (110 degrees F or above) or low temperatures (50 degrees F or below) and a minimum of 10 percent of randomly selected anchors. Anchor selection will be determined by the Post-Installed Anchor Special Inspector.
    b. Perform confined tension proof load testing in accordance with ASTM E488/E488M. Use incremental loading for tensile test. Maintain proof load for a minimum of 10 seconds. Consider anchors to have failed if displacement exceeds 2.5 mm or D/10, where D is the nominal anchor diameter, or if any of the failure modes listed in ASTM E488/E488M occur.
    c. Adhesive anchors and capsule anchors must not be torque tested.
    d. Proof loads must be the lesser of 50 percent of the expected peak load based on adhesive bond strength or 80 percent of the anchor yield strength.

D. Special Inspections for Post-Installed Mechanical Anchors:

1. As a minimum, the special inspector shall provide periodic special inspection for the following items:

    a. Hole drilling method in accordance with the MPII.

1) Verify initial installations of each type and size of adhesive anchor by construction personnel on site, including examination of drill bits and hole sizes.
2) Subsequent installations of the same anchor type and size by the same construction personnel shall be permitted to be performed in the absence of the special inspector.
3) Any change in the anchor product being installed or the personnel performing the installation shall require an initial inspection.
4) For ongoing installations installed over an extended period, the special inspector shall make regular inspections to confirm correct hole drilling procedures are followed.

2. As a minimum, the special inspector shall provide continuous special inspection for the following items:

   a. Anchor edge distance and spacing.
   b. Hole diameter and depth.
   c. Hole cleaning in accordance with the MPII.
   d. Anchor element type, material, diameter, and length.

3. For mechanical anchors whose strength is dependent on a minimum installation torque, the installer under the supervision of the Special Inspector must torque test the anchors with a calibrated torque wrench.

   a. Perform torque testing immediately on the first three anchors of each type and size, for each installer, and a minimum of 10 percent of randomly selected anchors. Anchor selection will be determined by the Post-Installed Anchor Special Inspector.

4. For mechanical anchors whose strength is not dependent on a minimum installation torque, the Special Inspector must perform proof loading.

   a. Perform proof loading on the first three anchors of each type and size, for each installer and a minimum of 10 percent of randomly selected anchors. Anchor selection will be determined by the Post-Installed Anchor Special Inspector.
   b. Perform confined tension proof load testing in accordance with ASTM E488/E488M. Use incremental loading for tensile test. Maintain proof load for a minimum of 10 seconds. Consider anchors to have failed if displacement exceeds 2.5 mm (0.1 inch) or D/10, where D is the nominal anchor diameter, or if any of the failure modes listed in ASTM E488 occur.
   c. Proof loads must be the minimum of the value shown on the Drawings, or 80 percent of the tension capacity of the anchor.

3.4 Post Installed Anchor Special Inspections Report

A. The special inspector shall furnish a report weekly to the licensed design professional and building official Include the following:

1. Exact locations of the inspected and tested work
2. Inspector's name
3. Date of inspection
4. Summary of work completed during the inspection period
5. Test results

6. Statement by the Special Inspector that clearly identifies the tested anchors as being acceptable or rejected.
7. Statement by the Special Inspector confirming that the materials and installation procedures conform with the approved contract documents and the manufacturer's published installation instructions.

3.5 Action Required from Failed Tests/Inspections:

A. Immediately report failed anchor locations and test results to the Engineer of Record . Anchors that fail to meet proof/torque load or installation requirements must be regarded as malfunctioning.

B. Do not re-use holes unless specifically allowed by manufacturer's published instructions and approved by the Post-Installed Anchor Special Inspector.

C. If any of the tested anchors fail to achieve the specified torque or proof load within the limits of the contract documents, test a minimum of two adjacent anchors for each anchor that fails.

D. Continuously special inspect and proof load/torque test any replacement anchors. Fill unused anchor holes and patch failed anchor locations in accordance with this specification. Prior to performing the repair, the Contractor must submit the proposed fill and patch materials to the Architect for approval.

E. Additional tests, repairs, delays, or modification of work to accommodate failed tests will be at no cost to the Owner.

END OF SECTION

SECTION 05 12 00 - STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Structural steel.
2. Field-installed shear connectors.
3. Grout.

B. Related Requirements:

1. Section 05 31 00 "Steel Decking" for field installation of shear connectors through deck.
2. Section 05 50 00 "Metal Fabrications" for steel lintels and shelf angles not attached to structural-steel frame, miscellaneous steel fabrications, and other steel items not defined as structural steel.
3. Section 09 96 00 "High-Performance Coatings" for surface-preparation and priming requirements.

1.2 DEFINITIONS

A. Structural Steel: Elements of the structural frame indicated on Drawings and as described in AISC 303, "Code of Standard Practice for Steel Buildings and Bridges."

B. Heavy Sections: Rolled and built-up sections as follows:

1. Shapes included in ASTM A 6 with flanges thicker than 1-1/2 inches.
2. Welded built-up members with plates thicker than 2 inches.
3. Column base plates thicker than 2 inches.

1.3 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.5 ACTION SUBMITTALS

A. General:

1. Submittals and shop drawings shall not be made by using reproductions of Contract Drawings.
2. Submittals and shop drawings shall be submitted through General Contractor to Architect. Any fabrication of material before approval of drawings will be at the risk of Contractor.

    a. Fabricated material and connections shall fit within architectural constraints.
    a. Fabricator alone shall be responsible for errors of detailing and fabrication.

3. Contractor shall provide a proposed submittal schedule showing anticipated steel shop drawing submission dates a minimum of two (2) weeks prior to the first steel shop drawing submittal.
4. Steel submissions shall be submitted such that each individual construction sequence is a separate standalone submittal package with an Erection Plan, Assembly Drawings, and Piece Mark Drawings. Typical Details, Connections, Calculations and Sections may be submitted as one submittal package at Contractors option, but must be received prior to the first sequence submission. Sequence submittals shall be submitted in the order that they will be Fabricated and Erected. Processing time for review of each sequence shall be allowed and shall not be assumed to be concurrent.
5. Sequences larger than the floor area of the largest single floor of the building will require additional review and processing time. Additional review and processing time shall not be assumed to be concurrent. Any sequence anticipated to be larger than the maximum single floor area shall be clearly indicated in the submittal schedule and brought to the Architect's/Engineer's attention for discussion of review times prior to submission of said sequence.

B. Product Data: For each type of product.

C. Sustainable Design Submittals:

1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.
2. Environmental Product Declaration: For each product.
3. Health Product Declaration: For each product.
4. Sourcing of Raw Materials: Corporate sustainability report for each manufacturer.
5. Sourcing of Raw Materials: Corporate sustainability report for each manufacturer.
6. Laboratory Test Reports for Credit IEQ 4: For primers, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

D. Shop Drawings: Show fabrication of structural-steel components. Submit in advance of fabrication complete shop drawings prepared under the supervision of fabricator's registered professional Engineer for fabrication of each component part of structural steel framing.

1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
2. Include embedment Drawings.
3. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld. Show backing bars that are to be removed and supplemental fillet welds where backing bars are to remain.

4. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical, high-strength bolted connections.
5. Include member sizes.
6. Include material specifications.
7. Indicate piece marks for field assembly.

E. Erection Drawings: Submit erection drawings (“E” Sheets) as part of shop drawings, showing complete information necessary for erection of each component part of structural steel framing.

1. Indicate setting drawings, templates and directions for installation of anchor rods and other anchorage devices embedded in concrete or masonry work.
2. Indicate dimensions for alignment and elevation of each member.
3. Indicate location of members and attachments by match-marking of piece members.
4. Indicate piece marks for field assembly.
5. Include type and location of each field connection, including splices.
6. Indicate required number and location of shear connectors on each member.
7. Indicate details of each field connection or typical connection.
8. Indicate size, length and type of bolts required in each field connection.

F. Welding Procedure Specifications (WPSs) and Procedure Qualification Records (PQRs): Provide according to AWS D1.1, "Structural Welding Code - Steel," for each welded joint whether prequalified or qualified by testing, including the following:

1. Power source (constant current or constant voltage).
2. Electrode manufacturer and trade name, for demand critical welds.

G. Delegated-Design Submittal: For structural-steel connections indicated to comply with design loads, include analysis data signed and sealed by the qualified professional engineer responsible for their preparation. Submit in advance of steel shop drawings. All connections shall be designed by the fabricator’s engineer per AISC 303 Section 3.1.1 Option 3.

1. Proposed variations in typical details shown on drawings will be considered and such variations must have preliminary approval prior to preparation of detailed shop drawings.
2. Connection drawings and details shall be prepared under supervision and sealed by a professional Engineer Registered in State of the project. Fabricator shall submit certification by professional Engineer that connection design is in accordance with applicable codes and specifications.
3. Fabricator’s engineer shall submit complete design calculations for each connection. Such calculations shall show details of assembled joint with bolts and welds required. Where predesigned connections are taken directly from tables in AISC Manual, calculations need not be submitted provided job design conditions precisely match those assumed in tables, data taken from tables is clearly identified with table number, and such connections are so indicated in calculations submitted. Design calculations shall be sealed by fabricator’s registered professional engineer. Shop drawings submitted without complete design calculations will not be approved.

H. Certificate of Conformance: Submit manufacturer’s certificate of conformance and/or supporting Charpy V-Notch test reports for complete-joint-penetration weld filler metal where steel backer bars for CJP groove welded T and corner joints are elected by the Contractor to remain in place. Certificate of Conformance or test reports shall show filler metal has a specified Charpy V-Notch toughness of 20 ft-lbs at 40 degrees F.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer, fabricator, shop-painting applicators, professional engineer, and testing agency.

B. Welding certificates.

C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.

D. Mill test reports for structural steel, including chemical and physical properties.

E. Product Test Reports: For the following:

1. Bolts, nuts, and washers including mechanical properties and chemical analysis.
2. Direct-tension indicators.
3. Tension-control, high-strength, bolt-nut-washer assemblies.
4. Shear stud connectors.
5. Shop primers.
6. Nonshrink grout.

F. Source quality-control reports.

G. Field quality-control and special inspection reports.

1.7 QUALITY ASSURANCE

A. Fabricator Qualifications: A qualified fabricator that participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category BU.

B. Installer Qualifications: A qualified installer who participates in the AISC Quality Certification Program and is designated an AISC-Certified Erector, Category CSE.

C. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code - Steel."

D. Comply with applicable provisions of the following specifications and documents:

1. AISC 303.

a. Section 3.1.1 and Section 3.3 is hereby modified by deletion of the “Commentary.”
b. Section 3.3 is hereby modified by deletion as follows: “When discrepancies exist between structural Design Drawings and the architectural, electrical, or mechanical Design Drawings or Design Drawings for other trades, the structural Design Drawings shall govern.”
c. Section 4.4 is hereby modified by deletion of the following: “The shop and erection drawings shall be returned to the fabricator within 14 calendar days.” Also delete “Commentary” in same section.

2. AISC 360.
3. RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to the site at such intervals to ensure uninterrupted progress of work.

B. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from corrosion and deterioration.

1. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.

C. Store fasteners in a protected place in sealed containers with manufacturer's labels intact.

1. Fasteners may be repackaged provided Owner's testing and inspecting agency observes repackaging and seals containers.
2. Clean and relubricate bolts and nuts that become dry or rusty before use.
3. Comply with manufacturers' written recommendations for cleaning and lubricating ASTM F 1852 fasteners and for retesting fasteners after lubrication.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Connections: Provide details of all connections required by the Contract Documents to be selected or completed by structural-steel fabricator, including comprehensive engineering analysis by a qualified professional engineer, to withstand loads indicated and comply with other information and restrictions indicated.

1. Select and complete connections using schematic details indicated and AISC 360.
2. Use Load and Resistance Factor Design; data are given at factored-load level.

B. Moment Connections: Type FR, fully restrained.

C. Construction: Combined system of moment frame and braced frame.

2.2 STRUCTURAL-STEEL MATERIALS

A. General: All structural steel materials to be domestically manufactured in the United States of America.

B. Recycled Content: Provide products with postconsumer recycled content plus one-half of preconsumer recycled content to the extent required to comply with the minimum criteria specified in Section 01 81 13.14 “Sustainable Design Requirements.”

C. See General Notes for Structural Steel ASTM designations and grades, u.n.o.

D. Steel Castings: ASTM A 216, Grade WCB with supplementary requirement S11.

E. Steel Forgings: ASTM A 668.

F. Welding Electrodes: Comply with AWS requirements.

2.3 BOLTS, CONNECTORS, AND ANCHORS

A. General:

1. Bolts, connectors, and anchors shall be new and not be reused.

B. High-Strength A325 Bolts, Nuts, and Washers: ASTM F3125, Grade A325, Type 1, heavy-hex steel structural bolts; ASTM A563, Grade D, heavy-hex carbon-steel nuts; and ASTM F436, Type 1, hardened carbon-steel washers; all with plain finish.

1. Direct-Tension Indicators: ASTM F 959, Type 325, compressible-washer type with plain finish.

C. High-Strength A490 Bolts, Nuts, and Washers: ASTM F3125, Grade A490, Type 1, heavy-hex steel structural bolts or Grade F2280 tension-control, bolt-nut-washer assemblies with splined ends; ASTM A563, Grade DH, heavy-hex carbon-steel nuts; and ASTM F436, Type 1, hardened carbon-steel washers; all with plain finish.

1. Direct-Tension Indicators: ASTM F 959, Type 490, compressible-washer type with plain finish.

D. Zinc-Coated High-Strength A325 Bolts, Nuts, and Washers: ASTM F3125, Grade A325, Type 1, heavy-hex steel structural bolts; ASTM A563, Grade DH, heavy-hex carbon-steel nuts; and ASTM F436, Type 1, hardened carbon-steel washers.

1. Finish: Hot-dip zinc coating.
2. Direct-Tension Indicators: ASTM F 959, Type 325, compressible-washer type with mechanically deposited zinc coating, baked epoxy-coated finish.

E. Shear Connectors: ASTM A 108, Grades 1015 through 1020, headed-stud type, cold-finished carbon steel; AWS D1.1, Type B.

F. Headed Anchor Rods: See general notes for grades. Rods shall be straight.

1. Nuts: ASTM A 563 heavy-hex carbon steel.
2. Plate Washers: ASTM A 36 carbon steel.
3. Washers: ASTM F 436, Type 1, hardened carbon steel.
4. Finish: Plain.

G. Threaded Rods: See general notes for grades.

1. Nuts: ASTM A 56 heavy-hex carbon steel.
2. Washers: ASTM A 36 carbon steel.
3. Finish: Hot-dip zinc coating, ASTM A 153, Class C.

2.4 PRIMER

A. Primer: Comply with Section 09 96 00 "High-Performance Coatings."

2.5 GROUT

A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive and nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

1. Non-metallic grout shall be used in all conditions unless noted otherwise.
2. Compressive strength at 7 days: 6000 psi minimum.
3. Compressive strength at 28 days: 8000 psi minimum.

2.6 FABRICATION

A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate according to AISC 303, "Code of Standard Practice for Steel Buildings and Bridges," and to AISC 360.

1. Camber structural-steel members where indicated.
2. Fabricate beams with rolling camber up.
3. Identify high-strength structural steel according to ASTM A 6 and maintain markings until structural steel has been erected.
4. Mark and match-mark materials for field assembly.
5. Complete structural-steel assemblies, including welding of units, before starting shop-priming operations.

B. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.

1. Plane thermally cut edges to be welded to comply with requirements in AWS D1.1.

C. Bolt Holes: Cut, drill, mechanically thermal cut, or punch standard bolt holes perpendicular to metal surfaces.

D. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.

E. Cleaning: Clean and prepare steel surfaces that are to remain unpainted according to SSPC-SP 1, "Solvent Cleaning."

F. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1 and manufacturer's written instructions.

G. Steel Wall-Opening Framing: Select true and straight members for fabricating steel wall-opening framing to be attached to structural-steel frame. Straighten as required to provide uniform, square, and true members in completed wall framing. Build up welded framing, weld exposed joints continuously, and grind smooth.

H. Welded Door Frames: Build up welded door frames attached to structural-steel frame. Weld exposed joints continuously and grind smooth. Plug-weld fixed steel bar stops to frames. Secure

removable stops to frames with countersunk machine screws, uniformly spaced not more than 10 inches o.c. unless otherwise indicated.

I. Holes: Provide holes required for securing other work to structural steel and for other work to pass through steel members.

1. Cut, drill, or punch holes perpendicular to steel surfaces. Do not thermally cut bolt holes or enlarge holes by burning.
2. Baseplate Holes: Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces.
3. Weld threaded nuts to framing and other specialty items indicated to receive other work.

2.7 SHOP CONNECTIONS

A. High-Strength Bolts: Shop install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.

1. Joint Type: Snug tightened.

B. Weld Connections: Comply with AWS D1.1 and AWS D1.8 for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.

1. Assemble and weld built-up sections by methods that maintain true alignment of axes without exceeding tolerances in AISC 303 for mill material.

2.8 SHOP PRIMING

A. Shop prime steel surfaces except the following:

1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches.
2. Surfaces to be field welded.
3. Surfaces of high-strength bolted, slip-critical connections.
4. Surfaces to receive sprayed fire-resistive materials (applied fireproofing).
5. Galvanized surfaces.

B. Surface Preparation: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces according to the following specifications and standards:

1. SSPC-SP 3, "Power Tool Cleaning."

C. Priming: Immediately after surface preparation, apply primer according to manufacturer's written instructions and at rate recommended by SSPC to provide a minimum dry film thickness of 1.5 mils. Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.

2.9 GALVANIZING

A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel according to ASTM A 123.

1. Fill vent and drain holes that are exposed in the finished Work unless they function as weep holes, by plugging with zinc solder and filing off smooth.
2. Galvanize lintels, shelf angles, and welded door frames attached to structural-steel frame and located in exterior walls.
3. Galvanize all steel exposed to weather, u.n.o.

2.10 SOURCE QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform shop tests and inspections.

1. Provide testing agency with access to places where structural-steel work is being fabricated or produced to perform tests and inspections.

B. Bolted Connections: Inspect and test shop-bolted connections according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

C. Welded Connections: Visually inspect shop-welded connections according to AWS D1.1 and the following inspection procedures, at testing agency's option:

1. Liquid Penetrant Inspection: ASTM E 165.
2. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
3. Ultrasonic Inspection: ASTM E 164.
4. Radiographic Inspection: ASTM E 94.

D. Full Penetration Welded Connections: In addition to visual inspection, complete joint penetration groove welds shall be ultrasonically tested for the entire weld length, in each designated joint per AWS D1.1 to the following extents:

1. 100 percent of welds splicing beams, girders, columns, or braces.
2. 100 percent of column to base plate welds at rigid (lateral) column frame bases.
3. 100 percent of CJP beam to column welds, continuity plate welds, and shear tabs.

E. Non-Destructive Testing of Welds:

1. Ultrasonic Testing (UT): ASTM E164

a. Divide connections into groups containing not less than 40 connections. Test 25 percent of the connections in each group. If any weld is rejected, test all the connections in group.

F. In addition to visual inspection, perform magnetic particle testing for full length of fillet welds on continuity plates and backing bar removal areas, and 25% of remaining fillet welds.

G. In addition to visual inspection, test and inspect shop-welded shear connectors according to requirements in AWS D1.1 for stud welding and as follows:

1. Perform bend tests if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear connector.
2. Conduct tests according to requirements in AWS D1.1 on additional shear connectors if weld fracture occurs on shear connectors already tested.

H. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify, with certified steel erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.

1. Prepare a certified survey of existing conditions. Include bearing surfaces, anchor rods, bearing plates, and other embedments showing dimensions, locations, angles, and elevations.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place unless otherwise indicated.

1. Do not remove temporary shoring supporting composite deck construction until cast-in-place concrete has attained its design compressive strength.

3.3 ERECTION

A. Set structural steel accurately in locations and to elevations indicated and according to AISC 303 and AISC 360.

B. Baseplates, bearing plates, and leveling plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates. Clean bottom surface of plates.

1. Set plates for structural members on wedges, shims, or setting nuts as required.
2. Weld plate washers to top of baseplate.
3. Snug-tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.

4. Promptly pack grout solidly between bearing surfaces and plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.

C. Maintain erection tolerances of structural steel within AISC 303, "Code of Standard Practice for Steel Buildings and Bridges."

D. Align and adjust various members that form part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that are in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.

1. Level and plumb individual members of structure.
2. Make allowances for difference between temperature at time of erection and mean temperature when structure is completed and in service.

E. Splice members only where indicated.

F. Do not use thermal cutting during erection.

G. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.

H. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1 and manufacturer's written instructions.

3.4 FIELD CONNECTIONS

A. High-Strength Bolts: Install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.

1. Joint Type: Snug tightened.

B. Weld Connections: Comply with AWS D1.1 and AWS D1.8 for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.

1. Comply with AISC 303 and AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.
2. Remove backing bars or runoff tabs, back gouge, and grind steel smooth. Backing bars MUST be removed if the project is in Seismic Design Category C and D. Contractor may elect to leave backing bars in place for all other projects if all following requirements are met:

a. Manufacturer shall submit a Certificate of Conformance and supporting Charpy V-Notch test reports showing filler metal used for backing bars has a toughness of 20 ft-lbs at 40 degrees F.
b. Certificate shall be received by the Engineer prior to the start of steel erection.

3. Assemble and weld built-up sections by methods that maintain true alignment of axes without exceeding tolerances in AISC 303, "Code of Standard Practice for Steel Buildings and Bridges," for mill material.

3.5 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections, and as required by the International Building Code:

1. Verify structural-steel materials and inspect steel frame joint details.
2. Verify weld materials and inspect welds.
3. Verify connection materials and inspect high-strength bolted connections.

B. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

C. General Field Inspection:

1. Verify location and setting of anchor rods by witness of Contractor’s final check prior to setting of steel members.
2. Verify plumbness of columns is within allowable tolerance per AISC Code and Commentary.
3. Verify that bracing and guying/cables, if required to secure framing during erection, are installed.

D. Bolted Connections: Inspect and test bolted connections according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

1. Minimum inspection requirements using the stated publication are as follows:

a. All bolts indicated to be “slip-critical” shall be inspected.
b. Two bolts in each bearing type bolted connection between girders and columns shall be inspected.
c. 10 percent of the remaining bolts, but not less than 2 in each connection shall be inspected.

2. Bolts that fail shall be retightened and all remaining bolts in the connection shall be retested. Costs of retests on connections that fail shall be the Contractor’s responsibility.

E. Welded Connections: Visually inspect field welds according to AWS D1.1.

1. In addition to visual inspection, test and inspect field welds according to AWS D1.1 and the following inspection procedures, at testing agency's option:

a. Liquid Penetrant Inspection: ASTM E 165.
b. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
c. Ultrasonic Inspection: ASTM E 164.
d. Radiographic Inspection: ASTM E 94.

2. In addition to visual inspection, 100 percent of full-penetration, moment connection field welds shall be ultrasonically tested according to AWS D1.1.

3. Column splice welds shall be inspected by ultrasonic testing per AWS D1.1 to the following extent:

    a. Rigid (Lateral) Columns: 100% of splice welds at each level shall be tested.
    b. Non-Frame Columns: 25% of splice welds at each level shall be tested.

4. Non-Destructive Testing of Remaining Welds:

    a. Ultrasonic Testing (UT): ASTM E164

        1) Divide connections into groups containing not less than 40 connections. Test 25 percent of the connections in each group. If any weld is rejected, test all the connections in group.

5. Extent of testing procedure shall be the entire weld length in each designated joint.
6. Welds found unacceptable shall be repaired by methods permitted in AWS code and be retested. Costs of repair and additional testing shall be the Contractor's responsibility.

F. In addition to visual inspection, test and inspect field-welded shear connectors according to requirements in AWS D1.1 for stud welding and as follows:

1. Perform bend tests if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear connector.
2. Conduct tests according to requirements in AWS D1.1 on additional shear connectors if weld fracture occurs on shear connectors already tested.

3.6 REPAIRS AND PROTECTION

A. Galvanized Surfaces: Clean areas where galvanizing is damaged or missing and repair galvanizing to comply with ASTM A 780.

B. Touchup Priming: Cleaning and touchup priming are specified in Section 09 96 00 "High-Performance Coatings."

END OF SECTION

This page is intentionally left blank.

SECTION 05 31 00 - STEEL DECKING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Roof deck.
2. Composite floor deck.

B. Related Requirements:

1. Section 03 30 00 "Cast-in-Place Concrete" for normal-weight and lightweight structural concrete fill over steel deck.
2. Section 05 12 00 "Structural Steel Framing" for shop- and field-welded shear connectors.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of deck, accessory, and product indicated.

B. Sustainable Design Submittals:

1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.

C. Shop Drawings:

1. Include layout and types of deck panels, anchorage details, reinforcing channels, pans, cut deck openings, special jointing, accessories, and attachments to other construction.

1.4 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Product Certificates: For each type of steel deck.

C. Product Test Reports: For tests performed by a qualified testing agency, indicating that each of the following complies with requirements:

1. Power-actuated mechanical fasteners.

D. Evaluation Reports: For steel deck, from ICC-ES.

E. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to ASTM E 329 for testing indicated.

B. Welding Qualifications: Qualify procedures and personnel according to AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."

C. FM Global Listing: Provide steel roof deck evaluated by FM Global and listed in its "Approval Guide, Building Materials" for Class 1 fire rating and Class 120 windstorm ratings.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Protect steel deck from corrosion, deformation, and other damage during delivery, storage, and handling.

B. Stack steel deck on platforms or pallets and slope to provide drainage. Protect with a waterproof covering and ventilate to avoid condensation.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. AISI Specifications: Comply with calculated structural characteristics of steel deck according to AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members."

B. Fire-Resistance Ratings: Comply with ASTM E 119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

C. Recycled Content: Provide products with postconsumer recycled content plus one-half of preconsumer recycled content to the extent required to comply with the minimum criteria specified in Section 01 81 13.14 “Sustainable Design Requirements.”

D. Low-Emitting Materials: Paints and coatings shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.2 ROOF DECK

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following, or approved equal:

1. ASC Profiles, Inc.; a Blue Scope Steel company.
2. Canam United States; Canam Group Inc.
3. CMC Joist & Deck.
4. Consolidated Systems, Inc.; Metal Dek Group.
5. Cordeck.
6. DACS, Inc.
7. Epic Metals Corporation.
8. Marlyn Steel Decks, Inc.
9. New Millennium Building Systems, LLC.
10. Nucor Corp.; Vulcraft Group.
11. Roof Deck, Inc.
12. Valley Joist; Subsidiary of EBSCO Industries, Inc.
13. Verco Manufacturing Co.
14. Wheeling Corrugating Company; Div. of Wheeling-Pittsburgh Steel Corporation.

B. Roof Deck: Fabricate panels, without top-flange stiffening grooves, to comply with "SDI Specifications and Commentary for Steel Roof Deck," in SDI Publication No. 31, and with the following:

1. Galvanized and Shop-Primed Steel Sheet: ASTM A 653/A 653M, Structural Steel (SS), Grade 50 (345), G90 zinc coating; cleaned, pretreated, and primed with manufacturer's standard baked-on, rust-inhibitive primer.

    a. Color: Manufacturer's standard.

2. Deck Profile: As indicated.
3. Design Uncoated-Steel Thickness: As indicated.
4. Span Condition: Triple span or more.
5. Side Laps: Overlapped.

2.3 COMPOSITE FLOOR DECK

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following, or approved equal:

1. ASC Profiles, Inc.; a Blue Scope Steel company.
2. Canam United States; Canam Group Inc.
3. CMC Joist & Deck.
4. Consolidated Systems, Inc.; Metal Dek Group.
5. Cordeck.
6. DACS, Inc.
7. Epic Metals Corporation.
8. Marlyn Steel Decks, Inc.
9. New Millennium Building Systems, LLC.
10. Nucor Corp.; Vulcraft Group.
11. Roof Deck, Inc.
12. Verco Manufacturing Co.

13. Wheeling Corrugating Company; Div. of Wheeling-Pittsburgh Steel Corporation.

B. Composite Floor Deck: Fabricate panels, with integrally embossed or raised pattern ribs and interlocking side laps, to comply with "SDI Specifications and Commentary for Composite Steel Floor Deck," in SDI Publication No. 31, with the minimum section properties indicated, and with the following:

1. Prime-Painted Steel Sheet: ASTM A 1008, Structural Steel (SS), Grade 50 (345) minimum, with top surface phosphatized and unpainted and underside surface shop primed with manufacturers' standard gray or white baked-on, rust-inhibitive primer.
2. Galvanized-Steel Sheet: ASTM A 653/A 653M, Structural Steel (SS), Grade 50 (345) minimum, G60 (Z180) zinc coating.
3. Galvanized and Shop-Primed Steel Sheet: ASTM A 653/A 653M, Structural Steel (SS), Grade 50 (345), G60 (Z180) zinc coating; with unpainted top surface and cleaned and pretreated bottom surface primed with manufacturer's standard gray or white baked-on, rust-inhibitive primer.
4. Profile Depth: As indicated.
5. Design Uncoated-Steel Thickness: As indicated.
6. Span Condition: Triple span or more.

2.4 ACCESSORIES

A. General: Provide manufacturer's standard accessory materials for deck that comply with requirements indicated.

B. Mechanical Fasteners: Corrosion-resistant, low-velocity, power-actuated or pneumatically driven carbon-steel fasteners; or self-drilling, self-threading screws.

C. Side-Lap Fasteners: Corrosion-resistant, hexagonal washer head; self-drilling, carbon-steel screws, No. 10 minimum diameter.

D. Flexible Closure Strips: Vulcanized, closed-cell, synthetic rubber.

E. Miscellaneous Sheet Metal Deck Accessories: Steel sheet, minimum yield strength of 33,000 psi, not less than 0.0359-inch design uncoated thickness, of same material and finish as deck; of profile indicated or required for application.

F. Pour Stops and Girder Fillers: Steel sheet, minimum yield strength of 33,000 psi, of same material and finish as deck, and of thickness and profile recommended by SDI Publication No. 31 for overhang and slab depth.

G. Column Closures, End Closures, Z-Closures, and Cover Plates: Steel sheet, of same material, finish, and thickness as deck unless otherwise indicated.

H. Piercing Hanger Tabs: Piercing steel sheet hanger attachment devices for use with floor deck.

I. Flat Sump Plates: Single-piece steel sheet, 0.0747 inch thick, of same material and finish as deck. For drains, cut holes in the field.

J. Recessed Sump Pans: Single-piece steel sheet, 0.0747 inch thick, of same material and finish as deck, with 3-inch- wide flanges and level recessed pans of 1-1/2-inch minimum depth. For drains, cut holes in the field.

K. Galvanizing Repair Paint: ASTM A 780/A 780M.

L. Repair Paint: Manufacturer's standard rust-inhibitive primer of same color as primer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine supporting frame and field conditions for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Install deck panels and accessories according to applicable specifications and commentary in SDI Publication No. 31, manufacturer's written instructions, and requirements in this Section.

B. Install temporary shoring before placing deck panels if required to meet deflection limitations.

C. Locate deck bundles to prevent overloading of supporting members.

D. Place deck panels on supporting frame and adjust to final position with ends accurately aligned and bearing on supporting frame before being permanently fastened. Do not stretch or contract side-lap interlocks.

E. Place deck panels flat and square and fasten to supporting frame without warp or deflection.

F. Cut and neatly fit deck panels and accessories around openings and other work projecting through or adjacent to deck.

G. Provide additional reinforcement and closure pieces at openings as required for strength, continuity of deck, and support of other work.

H. Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used for correcting welding work.

I. Mechanical fasteners may be used in lieu of welding to fasten deck. Locate mechanical fasteners and install according to deck manufacturer's written instructions.

3.3 ROOF-DECK INSTALLATION

A. Deck attachment shall be sufficient to develop diaphragm shear strength capacity indicated on the drawings, and shall be in accordance with the manufacturer’s recommendations. Attachment guidelines indicated in sections 3.3B through 3.3D are minimum requirements only.

B. Fasten roof-deck panels to steel supporting members by arc spot (puddle) welds of the surface diameter indicated or arc seam welds with an equal perimeter that is not less than 1-1/2 inches long, and as follows:

1. Weld Diameter: 5/8 inch, nominal.
2. Fastening Pattern: 32/5, minimum for 32” wide; 24/4, minimum for 24’ wide.
3. Weld Washers: Install weld washers at each weld location where metal thickness is less than 0.028 inches. Weld washers shall have a minimum thickness of 0.0598 inches and have a nominal 3/8 inch diameter whole.

C. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports, at intervals not exceeding the lesser of one-half of the span or 27 inches, and a minimum of 4 fasteners between supports, whichever results in more fasteners. Use one of the two attachment methods.

1. Mechanically fasten with self-drilling, No. 10 diameter or larger, carbon-steel screws.
2. Mechanically clinch or button punch.

D. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 1-1/2 inches, with end joints as follows:

1. End Joints: Lapped 2 inches minimum.

E. Roof Sump Pans and Sump Plates: Install over openings provided in roof deck and mechanically fasten flanges to top of deck. Space mechanical fasteners not more than 12 inches apart with at least one fastener at each corner.

1. Install reinforcing channels or zees in ribs to span between supports and mechanically fasten.

F. Miscellaneous Roof-Deck Accessories: Install ridge and valley plates, finish strips, end closures, and reinforcing channels according to deck manufacturer's written instructions. Mechanically fasten to substrate to provide a complete deck installation.

1. Weld cover plates at changes in direction of roof-deck panels unless otherwise indicated.

G. Flexible Closure Strips: Install flexible closure strips over partitions, walls, and where indicated. Install with adhesive according to manufacturer's written instructions to ensure complete closure.

3.4 FLOOR-DECK INSTALLATION

A. Fasten floor-deck panels to steel supporting members by arc spot (puddle) welds of the surface diameter indicated and as follows:

1. Weld Diameter: 5/8 inch, nominal.
2. Pattern: 36/4
3. Weld Washers: Install weld washers at each weld location where metal thickness is less than 0.028 inches. Weld washers shall have a minimum thickness of 0.0598 inches and have a nominal 3/8 inch diameter whole.

B. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports, at intervals not exceeding the lesser of one-half of the span or 36 inches, and as follows:
   1. Fasten with a minimum of 1-1/2-inch- long welds.

C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 1-1/2 inches, with end joints as follows:

   1. End Joints: Butted.

D. Pour Stops and Girder Fillers: Weld steel sheet pour stops and girder fillers to supporting structure according to SDI recommendations unless otherwise indicated.

E. Floor-Deck Closures: Weld steel sheet column closures, cell closures, and Z-closures to deck, according to SDI recommendations, to provide tight-fitting closures at open ends of ribs and sides of deck.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Field welds will be subject to inspection.

C. Prepare test and inspection reports.

D. Remove and replace work that does not comply with specified requirements.

E. Additional inspecting, at Contractor's expense, will be performed to determine compliance of corrected work with specified requirements.

3.6 PROTECTION

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on both surfaces of deck with galvanized repair paint according to ASTM A 780/A 780M and manufacturer's written instructions.

END OF SECTION

This page is intentionally left blank.

SECTION 05 40 00 - COLD-FORMED METAL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Load-bearing wall framing.
2. Exterior non-load-bearing wall framing.
3. Floor joist framing.

B. Related Requirements:

1. Section 092116.23 "Gypsum Board Shaft Wall Assemblies" for interior non-load-bearing, metal-stud-framed, shaft-wall assemblies, with height limitations.
2. Section 092216 "Non-Structural Metal Framing" for standard, interior non-load-bearing, metal-stud framing, with height limitations and ceiling-suspension assemblies.

1.2 ACTION SUBMITTALS

A. Product Data: For the following:

1. Cold-formed steel framing materials.
2. Load-bearing wall framing.
3. Exterior non-load-bearing wall framing.
4. Vertical deflection clips.
5. Single deflection track.
6. Floor joist framing.
7. Power-actuated anchors.

B. Sustainable Design Submittals:

1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.
2. Environmental Product Declaration: For each product.
3. Health Product Declaration: For each product.
4. Sourcing of Raw Materials: Corporate sustainability report for each manufacturer.

C. Shop Drawings: Signed and sealed by the design professional responsible for their preparation.

1. Include layout, spacings, sizes, thicknesses, and types of cold-formed steel framing; fabrication; and fastening and anchorage details, including mechanical fasteners.
2. Indicate reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachment to adjoining work.

D. Delegated Design Submittal: For cold-formed steel framing, including calculations signed and sealed by the design professional responsible for their preparation.

1.3 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Product Certificates: For each type of code-compliance certification for studs and tracks.

C. Research Reports:

1. For power-actuated fasteners, from ICC-ES or other qualified testing agency acceptable to authorities having jurisdiction.

1.4 QUALITY ASSURANCE

A. Product Tests: Mill certificates or data from a qualified independent testing agency indicating steel sheet complies with requirements, including base-metal thickness, yield strength, tensile strength, total elongation, chemical requirements, and metallic-coating thickness.

B. Code-Compliance Certification of Studs and Tracks: Provide documentation that framing members are certified according to the product-certification program of the Certified Steel Stud Association, the Steel Framing Industry Association, the Steel Stud Manufacturers Association, or the Supreme Steel Framing System Association.

C. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."

1.5 DELIVERY, STORAGE, AND HANDLING

A. Protect and store cold-formed steel framing from corrosion, moisture staining, deformation, and other damage during delivery, storage, and handling as required in AISI S202.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design cold-formed steel framing.

B. Structural Performance: Provide cold-formed steel framing capable of withstanding design loads within limits and under conditions indicated.

1. Design Loads: As indicated on Drawings.
2. Deflection Limits: Design framing systems to withstand design loads without deflections greater than the following:

a. Exterior Non-Load-Bearing Framing: Horizontal deflection of 1/360 of the wall height.

b. Floor Joist Framing: Vertical deflection of 1/360 for live loads and l/240 for total loads of the span.

3. Design framing systems to provide for movement of framing members located outside the insulated building envelope without damage or overstressing, sheathing failure, connection failure, undue strain on fasteners and anchors, or other detrimental effects when subject to a maximum ambient temperature change of 120 deg F.
4. Design framing system to maintain clearances at openings, to allow for construction tolerances, and to accommodate live load deflection of primary building structure as follows:

   a. Upward and downward movement of as indicated on Drawings.

5. Design exterior non-load-bearing wall framing to accommodate horizontal deflection without regard for contribution of sheathing materials.

C. Cold-Formed Steel Framing Standards: Unless more stringent requirements are indicated, framing complies with AISI S100 and AISI S240.

2.2 COLD-FORMED STEEL FRAMING MATERIALS

A. Recycled Content of Steel Products: Provide products with postconsumer recycled content plus one-half of preconsumer recycled content to the extent required to comply with the minimum criteria specified in Section 01 81 13.14 “Sustainable Design Requirements.”

B. Framing Members, General: Comply with AISI S240 for conditions indicated.

C. Steel Sheet: ASTM A1003/A1003M, Structural Grade, Type H, metallic coated, of grade and coating designation as follows:

1. Grade: As indicated on Drawings.
2. Coating: G90.

D. Steel Sheet for Vertical Deflection Clips: ASTM A653/A653M, structural steel, zinc coated, of grade and coating as follows:

1. Grade: As required by structural performance and to match studs, whichever is greater.
2. Coating: G90.

2.3 LOAD-BEARING WALL FRAMING

A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, and as follows:

1. Minimum Base-Metal Thickness: 0.0538 inch.
2. Flange Width: 1-5/8 inches minimum.

B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with straight flanges, and as follows:

1. Minimum Base-Metal Thickness: 0.0538 inch.

2. Flange Width: 1-1/4 inches.

2.4 EXTERIOR NON-LOAD-BEARING WALL FRAMING

A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, and as follows:

1. Minimum Base-Metal Thickness: 0.0538 inch.
2. Flange Width: 1-5/8 inches.

B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with unstiffened flanges, and as follows:

1. Minimum Base-Metal Thickness: Matching steel studs.
2. Flange Width: 1-1/4 inches.

C. Vertical Deflection Clips, Exterior: Manufacturer's standard bypass or head clips, as applicable, capable of accommodating upward and downward vertical displacement of primary structure through positive mechanical attachment to stud web.

D. Single Deflection Track: Manufacturer's single, deep-leg, U-shaped vertically slotted steel track; with unstiffened flanges, of web depth to contain studs while allowing free vertical movement, with flanges designed to support horizontal loads and transfer them to the primary structure, and as follows:

1. Minimum Base-Metal Thickness: 0.0538 inch.
2. Flange Width: 1 inch plus the design gap for one-story structures and 1 inch plus twice the design gap for other applications.

E. Drift Clips: Manufacturer's standard bypass or head clips, capable of isolating wall stud from upward and downward vertical displacement and lateral drift of primary structure through positive mechanical attachment to stud web and structure.

2.5 FLOOR JOIST FRAMING

A. Steel Joists: Manufacturer's standard C-shaped steel joists, of web depths indicated or as required to comply with Performance Requirements, punched with standard holes, with stiffened flanges, and as follows:

1. Minimum Base-Metal Thickness: 0.0538 inch.
2. Flange Width: 1-5/8 inches, minimum.

B. Steel Joist Track: Manufacturer's standard U-shaped steel joist track, of web depths indicated, unpunched, with unstiffened flanges, and as follows:

1. Minimum Base-Metal Thickness: 0.0538 inch.
2. Flange Width: 1-1/4 inches, minimum.

2.6 FRAMING ACCESSORIES

A. Fabricate steel-framing accessories from ASTM A1003/A1003M, Structural Grade, Type H, metallic coated steel sheet, of same grade and coating designation used for framing members.

B. Provide accessories of manufacturer's standard thickness and configuration, unless otherwise indicated, as follows:

1. Supplementary framing.
2. Bracing, bridging, and solid blocking.
3. Web stiffeners.
4. Anchor clips.
5. End clips.
6. Stud kickers and knee braces.
7. Joist hangers and end closures.
8. Hole-reinforcing plates.
9. Backer plates.

2.7 ANCHORS, CLIPS, AND FASTENERS

A. Steel Shapes and Clips: ASTM A36/A36M, zinc coated by hot-dip process according to ASTM A123/A123M.

B. Power-Actuated Anchors: Fastener systems with working capacity greater than or equal to the design load, according to an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.

C. Mechanical Fasteners: ASTM C1513, corrosion-resistant-coated, self-drilling, self-tapping, steel drill screws.

1. Head Type: Low-profile head beneath sheathing; manufacturer's standard elsewhere.

D. Welding Electrodes: Comply with AWS standards.

2.8 MISCELLANEOUS MATERIALS

A. Galvanizing Repair Paint: ASTM A780/A780M.

B. Nonmetallic, Nonshrink Grout: Factory-packaged, nonmetallic, noncorrosive, nonstaining grout, complying with ASTM C1107/C1107M, and with a fluid consistency and 30-minute working time.

C. Shims: Load-bearing, high-density, multimonomer, nonleaching plastic; or cold-formed steel of same grade and metallic coating as framing members supported by shims.

2.9 FABRICATION

A. Fabricate cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened, according to referenced AISI's specifications and standards, manufacturer's written instructions, and requirements in this Section.

1. Fabricate framing assemblies using jigs or templates.
2. Cut framing members by sawing or shearing; do not torch cut.

3. Fasten cold-formed steel framing members by welding, screw fastening, clinch fastening, pneumatic pin fastening, or riveting as standard with fabricator. Wire tying of framing members is not permitted.

    a. Comply with AWS D1.3/D1.3M requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
    b. Locate mechanical fasteners and install according to Shop Drawings, with screws penetrating joined members by no fewer than three exposed screw threads.

4. Fasten other materials to cold-formed steel framing by welding, bolting, pneumatic pin fastening, or screw fastening, according to Shop Drawings.

B. Reinforce, stiffen, and brace framing assemblies to withstand handling, delivery, and erection stresses. Lift fabricated assemblies by means that prevent damage or permanent distortion.

C. Tolerances: Fabricate assemblies level, plumb, and true to line to a maximum allowable variation of 1/8 inch in 10 feet and as follows:

1. Spacing: Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error are not to exceed minimum fastening requirements of sheathing or other finishing materials.
2. Squareness: Fabricate each cold-formed steel framing assembly to a maximum out-of-square tolerance of 1/8 inch.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, conditions, and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Before sprayed fire-resistive materials are applied, attach continuous angles, supplementary framing, or tracks to structural members indicated to receive sprayed fire-resistive materials.

B. After applying sprayed fire-resistive materials, remove only as much of these materials as needed to complete installation of cold-formed framing without reducing thickness of fire-resistive materials below that required to obtain fire-resistance ratings indicated. Protect remaining fire-resistive materials from damage.

3.3 INSTALLATION, GENERAL

A. Cold-formed steel framing may be shop or field fabricated for installation, or it may be field assembled.

B. Install cold-formed steel framing according to AISI S200, AISI S202, and manufacturer's written instructions unless more stringent requirements are indicated.

C. Install shop- or field-fabricated, cold-formed framing and securely anchor to supporting structure.

1. Screw, bolt, or weld wall panels at horizontal and vertical junctures to produce flush, even, true-to-line joints with maximum variation in plane and true position between fabricated panels not exceeding 1/16 inch.

D. Install cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened.

1. Cut framing members by sawing or shearing; do not torch cut.
2. Fasten cold-formed steel framing members by welding, screw fastening, clinch fastening, or riveting. Wire tying of framing members is not permitted.

a. Comply with AWS D1.3/D1.3M requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
b. Locate mechanical fasteners, install according to Shop Drawings, and comply with requirements for spacing, edge distances, and screw penetration.

E. Install framing members in one-piece lengths unless splice connections are indicated for track or tension members.

F. Install temporary bracing and supports to secure framing and support loads equal to those for which structure was designed. Maintain braces and supports in place, undisturbed, until entire integrated supporting structure has been completed and permanent connections to framing are secured.

G. Install insulation, specified in Section 072100 "Thermal Insulation," in framing-assembly members, such as headers, sills, boxed joists, and multiple studs at openings, that are inaccessible on completion of framing work.

H. Fasten hole-reinforcing plate over web penetrations that exceed size of manufacturer's approved or standard punched openings.

3.4 INSTALLATION OF LOAD-BEARING WALL FRAMING

A. Install continuous top and bottom tracks sized to match studs. Align tracks accurately and securely anchor at corners and ends, and at spacings as follows:

1. Anchor Spacing: As shown on Shop Drawings.

B. Squarely seat studs against top and bottom tracks, with gap not exceeding 1/8 inch between the end of wall-framing member and the web of track.

1. Fasten both flanges of studs to top and bottom tracks.
2. Space studs as follows:

a. Stud Spacing: As required to comply with Performance Requirements but not greater than 16 inches.

C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar configurations.

D. Align studs vertically where floor framing interrupts wall-framing continuity. Where studs cannot be aligned, continuously reinforce track to transfer loads.

E. Align floor framing over studs according to AISI S200, Section C1. Where framing cannot be aligned, continuously reinforce track to transfer loads.

F. Install supplementary framing, blocking, and bracing in stud framing indicated to support fixtures, equipment, services, casework, heavy trim, furnishings, and similar work requiring attachment to framing.

1. If type of supplementary support is not indicated, comply with stud manufacturer's written recommendations and industry standards in each case, considering weight or load resulting from item supported.

G. Install miscellaneous framing and connections, including supplementary framing, web stiffeners, clip angles, continuous angles, anchors, and fasteners, to provide a complete and stable wall-framing system.

3.5 INSTALLATION OF EXTERIOR NONLOADBEARING WALL FRAMING

A. Install continuous tracks sized to match studs. Align tracks accurately and securely anchor to supporting structure.

B. Fasten both flanges of studs to bottom track unless otherwise indicated. Space studs as follows:

1. Stud Spacing: As required to comply with Performance Requirements but not greater than 16 inches.

C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar requirements.

D. Isolate non-load-bearing steel framing from building structure to prevent transfer of vertical loads while providing lateral support.

1. Install single deep-leg deflection tracks and anchor to building structure.
2. Connect vertical deflection clips to bypassing studs and anchor to building structure.
3. Connect drift clips to cold-formed steel framing and anchor to building structure.

E. Install horizontal bridging in wall studs, spaced vertically in rows indicated on Shop Drawings but not more than 48 inches apart. Fasten at each stud intersection.

1. Channel Bridging: Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs.

F. Top Bridging for Single Deflection Track: Install row of horizontal bridging within 18 inches of single deflection track.

G. Install miscellaneous framing and connections, including stud kickers, web stiffeners, clip angles, continuous angles, anchors, and fasteners, to provide a complete and stable wall-framing system.

3.6 INSTALLATION OF JOIST FRAMING

A. Install perimeter joist track sized to match joists. Align and securely anchor or fasten track to supporting structure at corners, ends, and spacings indicated on Shop Drawings.

B. Install joists bearing on supporting frame, level, straight, and plumb; adjust to final position, brace, and reinforce. Fasten joists to both flanges of joist track.

1. Install joists over supporting frame with a minimum end bearing of 1-1/2 inches.
2. Reinforce ends and bearing points of joists with web stiffeners, end clips, joist hangers, steel clip angles, or steel-stud sections.

C. Space joists not more than 2 inches from abutting walls, and as follows:

1. Joist Spacing: As required to comply with Performance Requirements but not greater than 16 inches.

D. Frame openings with built-up joist headers, consisting of joist and joist track or another combination of connected joists if indicated.

E. Install joist reinforcement at interior supports with single, short length of joist section located directly over interior support, with lapped joists of equal length to joist reinforcement.

1. Install web stiffeners to transfer axial loads of walls above.

F. Install bridging at intervals indicated on Shop Drawings. Fasten bridging at each joist intersection as follows:

1. Combination Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated on Shop Drawings and joist-track solid blocking of width and thickness indicated. Fasten flat straps to bottom flange of joists and secure solid blocking to joist webs.

G. Secure joists to load-bearing interior walls to prevent lateral movement of bottom flange.

H. Install miscellaneous joist framing and connections, including web stiffeners, closure pieces, clip angles, continuous angles, hold-down angles, anchors, and fasteners, to provide a complete and stable joist-framing assembly.

3.7 INSTALLATION TOLERANCES

A. Install cold-formed steel framing level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet and as follows:

1. Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error are not to exceed minimum fastening requirements of sheathing or other finishing materials.

3.8 REPAIR

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed steel framing with galvanized repair paint according to ASTM A780/A780M and manufacturer's written instructions.

3.9 FIELD QUALITY CONTROL

A. Testing: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Field and shop welds will be subject to testing and inspecting.

C. Testing agency will report test results promptly and in writing to Contractor and Architect.

D. Cold-formed steel framing will be considered defective if it does not pass tests and inspections.

E. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.10 PROTECTION

A. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that cold-formed steel framing is without damage or deterioration at time of Substantial Completion.

END OF SECTION

SECTION 05 50 00 - METAL FABRICATIONS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Miscellaneous framing and supports.
2. Metal ladders.
3. Elevator pit sump covers.
4. Miscellaneous steel trim.
5. Metal bollards.
6. Pipe and downspout guards.

1.2 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written instructions to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of metal fabrications that are anchored to or that receive other work. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

1.3 ACTION SUBMITTALS

A. Product Data:

1. Nonslip aggregates and nonslip-aggregate surface finishes.
2. Fasteners.
3. Shop primers.
4. Shrinkage-resisting grout.
5. Metal bollards.
6. Pipe and downspout guards.

B. Shop Drawings: Show fabrication and installation details. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items. Provide Shop Drawings for the following:

1. Miscellaneous framing and supports for applications where framing and supports are not specified in other Sections.
2. Steel shapes for supporting elevator door sills.
3. Metal ladders.
4. Elevator pit sump covers.
5. Miscellaneous steel trim including steel angle corner guards.
6. Metal bollards.

C. Delegated Design Submittals: For ladders, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

D. Sustainable Design Submittals:

1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.
2. Environmental product declaration.
3. Health Product Declaration (HPD): For each product.
4. Sourcing of Raw Materials: Corporate sustainability report for each manufacturer.

1.4 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.

C. Delegated design engineer qualifications.

1.5 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel in accordance with the following welding codes:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."

1.6 FIELD CONDITIONS

A. Field Measurements: Verify actual locations of walls, floor slabs, decks, and other construction contiguous with metal fabrications by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design ladders.

2.2 METALS

A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

B. Recycled Content: Provide products with postconsumer recycled content plus one-half of preconsumer recycled content to the extent required to comply with the minimum criteria specified in Section 01 81 13.14 “Sustainable Design Requirements.”

C. Regional Materials: To the extent required to comply with the minimum criteria specified in Section 01 81 13.14 “Sustainable Design Requirements,” manufacture products within 100 miles of Project site from materials that have been extracted, harvested, or recovered, as well as manufactured, within 100 miles of Project site.

D. Steel Plates, Shapes, and Bars: ASTM A36/A36M.

E. Steel Tubing: ASTM A500/A500M, cold-formed steel tubing.

F. Steel Pipe: ASTM A53/A53M, Standard Weight (Schedule 40) unless otherwise indicated.

G. Rolled-Steel Floor Plate: ASTM A786/A786M, rolled from plate complying with ASTM A36/A36M or ASTM A283/A283M, Grade C or D.

2.3 FASTENERS

A. General: Unless otherwise indicated, provide Type 316 stainless steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.

1. Provide stainless steel fasteners for fastening aluminum, stainless steel, or nickel silver.

B. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A307, Grade A; with hex nuts, ASTM A563; and, where indicated, flat washers.

C. Anchor Bolts: ASTM F1554, Grade 36, of dimensions indicated; with nuts, ASTM A563; and, where indicated, flat washers.

1. Hot-dip galvanize or provide mechanically deposited, zinc coating where item being fastened is indicated to be galvanized.

D. Anchors, General: Capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing in accordance with ASTM E488/E488M, conducted by a qualified independent testing agency.

E. Cast-in-Place Anchors in Concrete: Either threaded or wedge type unless otherwise indicated; galvanized ferrous castings, either ASTM A47/A47M malleable iron or ASTM A27/A27M cast steel. Provide bolts, washers, and shims as needed, all hot-dip galvanized per ASTM F2329/F2329M.

F. Post-Installed Anchors: As specified in Section 05 05 19 “Post-Installed Anchors.”

2.4 MISCELLANEOUS MATERIALS

A. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.

B. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.

C. Shrinkage-Resistant Grout: Factory-packaged, nonmetallic, nonstaining, noncorrosive, nongaseous grout complying with ASTM C1107/C1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.

D. Concrete: Comply with requirements in Section 03 30 00 "Cast-in-Place Concrete" for normal-weight, air-entrained concrete with a minimum 28-day compressive strength of 3000 psi for interior applications and 4500 psi for exterior applications.

E. Structural Thermal Break: Structural, high-density, closed cell, rigid polyurethane foam thermal break pad.

1. Basis-of-Design Product: Subject to compliance with requirement, provide **Fabreeka; Fabreeka-TIM RF Series** or comparable product.
2. Ultimate compressive stress: 640 lbf./sq.in.
3. R-value per inch: 3.10; ASTM C518
4. Density: 15 lb./cu. ft.; ASTM D1622

2.5 FABRICATION, GENERAL

A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.

B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

D. Form exposed work with accurate angles and surfaces and straight edges.

E. Weld corners and seams continuously to comply with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) fasteners unless otherwise indicated. Locate joints where least conspicuous.

G. Fabricate seams and other connections that are exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.

H. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.

I. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.

J. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors, 1/8 by 1-1/2 inches, with a minimum 6-inch embedment and 2-inch hook, not less than 8 inches from ends and corners of units and 24 inches o.c., unless otherwise indicated.

2.6 MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.

B. Fabricate units from steel shapes, plates, and bars of welded construction unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction.

1. Fabricate units from slotted channel framing where indicated.
2. Furnish inserts for units installed after concrete is placed.

C. Fabricate supports for operable partitions from continuous steel beams of sizes indicated with attached bearing plates, anchors, and braces as indicated. Drill or punch bottom flanges of beams to receive partition track hanger rods; locate holes where indicated on operable partition Shop Drawings.

D. Galvanize miscellaneous framing and supports where indicated.

E. Prime miscellaneous framing and supports not indicated to be galvanized with zinc-rich primer specified in Section 09 96 00 "High-Performance Coatings."

2.7 METAL LADDERS AND CROSSOVER PLATFORMS

A. General:

1. Comply with ANSI A14.3, except for elevator pit ladders.
2. For elevator pit ladders, comply with ASME A17.1/CSA B44.

B. Steel Ladders: Unless noted otherwise on Drawings or required to comply with Performance Requirements provide the following:

1. Space siderails 18 inches apart unless otherwise indicated.
2. Siderails: Continuous, 3/8-by-2-1/2-inch steel flat bars, with eased edges.
3. Rungs: 1-inch-square, steel bars.
4. Fit rungs in centerline of siderails; plug-weld and grind smooth on outer rail faces.
5. Nonslip Surfaces for Steel Ladders: Provide nonslip surfaces on top of each rung by coating with abrasive material metallically bonded to rung.

a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1) IKG.
2) SlipNOT Metal Safety Flooring, division of Traction Technologies Holdings, LLC.

6. Source Limitations: Obtain nonslip surfaces from single source from single manufacturer.
7. Support each ladder at top and bottom and not more than 60 inches o.c. with welded or bolted steel brackets.
8. Galvanize ladders and crossover platforms, including brackets.
9. Provide platforms as indicated, fabricated from rolled steel floor plate supported by galvanized steel framing.

2.8 ELEVATOR PIT SUMP COVERS

A. Fabricate from welded or pressure-locked galvanized steel bar grating. Limit openings in gratings to no more than 1/2 inch in least dimension.

B. Provide steel angle supports unless otherwise indicated.

2.9 MISCELLANEOUS STEEL TRIM

A. Unless otherwise indicated, fabricate units from steel shapes, plates, and bars of profiles shown with continuously welded joints and smooth exposed edges. Miter corners and use concealed field splices where possible.

B. Provide cutouts, fittings, and anchorages as needed to coordinate assembly and installation with other work.

1. Provide with integrally welded steel strap anchors for embedding in concrete or masonry construction.

C. Galvanize miscellaneous steel trim.

2.10 METAL BOLLARDS

A. Fabricate metal bollards from steel shapes, as indicated.

B. Prime steel bollards with zinc-rich primer specified in Section 09 96 00 "High-Performance Coatings."

2.11 PIPE AND DOWNSPOUT GUARDS

A. Fabricate pipe and downspout guards from 3/8-inch-thick by 12-inch-wide, steel plate, bent to fit flat against the wall or column at both ends and to fit around pipe with 2-inch clearance between pipe and pipe guard. Drill each end for two 3/4-inch anchor bolts.

B. Galvanize steel pipe and downspout guards.

2.12 LOOSE STEEL LINTELS

A. Fabricate loose steel lintels from steel angles and shapes of size indicated for openings and recesses in masonry walls and partitions at locations indicated. Fabricate in single lengths for each opening unless otherwise indicated. Weld adjoining members together to form a single unit where indicated.

B. Size loose lintels to provide bearing length at each side of openings equal to one-twelfth of clear span, but not less than 8 inches unless otherwise indicated.

C. Galvanize loose steel lintels located in exterior walls.

2.13 STEEL WELD PLATES AND ANGLES

A. Provide steel weld plates and angles not specified in other Sections, for items supported from concrete construction as needed to complete the Work. Provide each unit with no fewer than two integrally welded steel strap anchors for embedding in concrete.

2.14 GENERAL FINISH REQUIREMENTS

A. Finish metal fabrications after assembly.

B. Finish exposed surfaces to remove tool and die marks and stretch lines, and to blend into surrounding surface.

2.15 STEEL AND IRON FINISHES

A. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A153/A153M for steel and iron hardware and with ASTM A123/A123M for other steel and iron products.

1. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.

B. Shop prime iron and steel items not indicated to be galvanized unless they are to be embedded in concrete, sprayed-on fireproofing, or masonry, or unless otherwise indicated.

C. Preparation for Shop Priming: Prepare surfaces to comply with SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.

B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.

C. Field Welding: Comply with the following requirements:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag screws, wood screws, and other connectors.

E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

F. Corrosion Protection: Coat concealed surfaces of aluminum that come into contact with grout, concrete, masonry, wood, or dissimilar metals with the following:

1. Cast Aluminum: Heavy coat of bituminous paint.
2. Extruded Aluminum: Two coats of clear lacquer.

3.2 INSTALLATION OF MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings.

B. Anchor supports for operable partitions, overhead doors, and similar overhead supports securely to, and rigidly brace from, building structure.

C. Anchor shelf angles securely to existing construction.

3.3 INSTALLATION OF METAL LADDERS AND CROSSOVER PLATFORMS

A. Secure ladders and crossover platforms to adjacent construction with the clip angles attached to the stringer.

B. Install brackets as required for securing of ladders and crossover platforms bolted to structural steel or built into masonry or concrete. At exterior ladders separate ladder clip from supporting structural steel with structural thermal break pads.

3.4 INSTALLATION OF ELEVATOR PIT SUMP COVERS

A. Install tops of elevator sump pit cover plates and frames flush with finished surface. Adjust as required to avoid lippage that could present a tripping hazard.

3.5 INSTALLATION OF MISCELLANEOUS STEEL TRIM

A. Anchor to concrete construction to comply with manufacturer's written instructions.

3.6 INSTALLATION OF METAL BOLLARDS

A. Anchor bollards to existing construction with expansion anchors. Provide four 3/4-inch bolts at each bollard unless otherwise indicated.

B. Anchor bollards in place with concrete footings where indicated. Center and align bollards in holes 3 inches above bottom of excavation. Place concrete and vibrate or tamp for consolidation. Support and brace bollards in position until concrete has cured.

C. Fill bollards solidly with concrete, mounding top surface to shed water.

1. Do not fill removable bollards with concrete.

3.7 INSTALLATION OF PIPE AND DOWNSPOUT GUARDS

A. Provide pipe guards at exposed vertical pipes in parking garage and at locations indicated on Drawings where not protected by curbs or other barriers. Install by bolting to wall or column with expansion anchors. Provide four 3/4-inch bolts at each pipe guard. Mount pipe guards with top edge 26 inches above driving surface.

3.8 REPAIRS

A. Touchup Painting:

1. Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

a. Apply by brush or spray to provide a minimum 2.0-mil dry film thickness.

2. Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Section 099611 "High-Performance Coatings."

B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A780/A780M.

END OF SECTION

SECTION 05 51 13 - METAL PAN STAIRS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Preassembled steel stairs with concrete-filled treads.
2. Steel tube railings and guards attached to metal stairs.
3. Steel tube handrails attached to walls adjacent to metal stairs.

1.2 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written instructions to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of anchorages for metal stairs, railings, and guards.

1. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, blocking for attachment of wall-mounted handrails, and items with integral anchors, that are to be embedded in concrete or masonry.
2. Deliver such items to Project site in time for installation.

C. Coordinate locations of hanger rods and struts with other work so they do not encroach on required stair width and are within fire-resistance-rated stair enclosure.

D. Schedule installation of railings and guards so wall attachments are made only to completed walls.

1. Do not support railings and guards temporarily by any means that do not satisfy structural performance requirements.

1.3 ACTION SUBMITTALS

A. Product Data: For metal pan stairs and the following:

1. Abrasive nosings.
2. Shop primer products.
3. Handrail wall brackets.
4. Grout.

B. Sustainable Design Submittals:

1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.
2. Environmental product declaration.
3. Sourcing of Raw Materials: Corporate sustainability report for each manufacturer.

C. Shop Drawings:

1. Include plans, elevations, sections, details, and attachments to other work.
2. Indicate sizes of metal sections, thickness of metals, profiles, holes, and field joints.
3. Include plan at each level.
4. Indicate locations of anchors, weld plates, and blocking for attachment of wall-mounted handrails.

D. Samples for Verification: For each type and finish of nosing.

E. Delegated Design Submittal: For stairs, railings and guards including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For professional engineer's experience with providing delegated design engineering services of the kind indicated, including documentation that engineer is licensed in the State in which Project is located.

B. Welding certificates.

C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Fabricator of products.

B. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store materials to permit easy access for inspection and identification.

1. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers.
2. Protect steel members and packaged materials from corrosion and deterioration.
3. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures.

a. Repair or replace damaged materials or structures as directed.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design stairs, railings and guards, including attachment to building construction.

B. Structural Performance of Stairs: Metal stairs withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

1. Uniform Load: 100 lbf/sq. ft..
2. Concentrated Load: 300 lbf applied on an area of 4 sq. in..
3. Uniform and concentrated loads need not be assumed to act concurrently.
4. Stair Framing: Capable of withstanding stresses resulting from railing and guard loads in addition to loads specified above.
5. Limit deflection of treads, platforms, and framing members to L/360 or 1/2 inch for total load deflection, and L/540 or 1/4 inch for live load deflection, whichever is less.

C. Structural Performance of Railings and Guards: Railings and guards, including attachment to building construction, withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

1. Handrails and Top Rails of Guards:

    a. Uniform load of 50 lbf/ft. applied in any direction.
    b. Concentrated load of 200 lbf applied in any direction.
    c. Uniform and concentrated loads need not be assumed to act concurrently.

2. Infill of Guards:

    a. Concentrated load of 50 lbf applied horizontally on an area of 1 sq. ft..
    b. Infill load and other loads need not be assumed to act concurrently.

2.2 METALS

A. Metal Surfaces: Provide materials with smooth, flat surfaces unless otherwise indicated. For components exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

B. Steel Plates, Shapes, and Bars: ASTM A36/A36M.

1. Recycled Content: Provide manufacturer documentation for recycled content, indicating postconsumer and preconsumer recycled content.
2. Regional Materials: Fabricate products within 100 miles of Project site from materials that have been extracted, harvested, or recovered within 100 miles of Project site.

C. Steel Tubing for Railings and Guards: ASTM A500/A500M (cold formed).

1. Recycled Content: Provide manufacturer documentation for recycled content, indicating postconsumer and preconsumer recycled content.

2. Regional Materials: Fabricate products within 100 miles of Project site from materials that have been extracted, harvested, or recovered within 100 miles of Project site.

D. Uncoated, Hot-Rolled Steel Sheet: ASTM A1011/A1011M, either commercial steel, Type B, or structural steel, Grade 30, unless another grade is required by design loads.

1. Recycled Content: Provide manufacturer documentation for recycled content, indicating postconsumer and preconsumer recycled content.
2. Regional Materials: Fabricate products within 100 miles of Project site from materials that have been extracted, harvested, or recovered within 100 miles of Project site.

2.3 ABRASIVE NOSINGS

A. Extruded Units: Aluminum units with abrasive filler consisting of aluminum oxide and silicon carbide, or a combination of both, in an epoxy-resin binder and with photoluminescent marking stripe as specified in Section 10 45 13 “Photoluminescent Egress Path Markings.” Fabricate units in lengths necessary to accurately fit openings or conditions.

B. Provide anchors for embedding units in concrete, either integral or applied to units, as standard with manufacturer.

C. Apply clear lacquer to concealed surfaces of extruded units set into concrete.

2.4 FASTENERS

A. General: Provide zinc-plated fasteners with coating complying with ASTM B633.

1. Select fasteners for type, grade, and class required.

B. Fasteners for Anchoring Railings and Guards to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings and guards to other types of construction indicated and capable of withstanding design loads.

C. Bolts and Nuts: Regular hexagon-head bolts, ASTM A307, Grade A; with hex nuts, ASTM A563; and, where indicated, flat washers.

D. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E488/E488M, conducted by a qualified independent testing agency.

1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, unless otherwise indicated.

2.5 MISCELLANEOUS MATERIALS

A. Handrail Wall Brackets: Stamped steel with center of rail 2-1/2 inches from face of wall.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

    a. Julius Blum & Co., Inc.
    b. The Wagner Companies.

B. Welding Electrodes: Comply with AWS requirements.

C. Shop Primers: Provide primers that comply with Section 09 91 23 "Interior Painting."

D. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.

E. Nonmetallic, Shrinkage-Resistant Grout: ASTM C1107/C1107M, factory-packaged, nonmetallic aggregate grout; recommended by manufacturer for interior use; noncorrosive and nonstaining; mixed with water to consistency suitable for application and a 30-minute working time.

2.6 FABRICATION, GENERAL

A. Provide complete stair assemblies, including metal framing, hangers, struts, railings and guards, clips, brackets, bearing plates, and other components necessary to support and anchor stairs and platforms on supporting structure.

1. Join components by welding unless otherwise indicated.
2. Use connections that maintain structural value of joined pieces.

B. Assemble stairs, railings, and guards in shop to greatest extent possible.

1. Disassemble units only as necessary for shipping and handling limitations.
2. Clearly mark units for reassembly and coordinated installation.

C. Cut, drill, and punch metals cleanly and accurately.

1. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated.
2. Remove sharp or rough areas on exposed surfaces.

D. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

E. Form exposed work with accurate angles and surfaces and straight edges.

F. Weld connections to comply with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. Weld exposed corners and seams continuously unless otherwise indicated.
5. At exposed connections, finish exposed welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Finish #1 - No evidence of welded joint.

G. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible.

1. Where exposed fasteners are required, use Phillips flat-head (countersunk) screws or bolts unless otherwise indicated.
2. Locate joints where least conspicuous.
3. Fabricate joints that will be exposed to weather in a manner to exclude water.
4. Provide weep holes where water may accumulate internally.

2.7 FABRICATION OF STEEL-FRAMED STAIRS

A. NAAMM Stair Standard: Comply with NAAMM AMP 510, "Metal Stairs Manual," for Architectural Class, unless more stringent requirements are indicated.

B. Stair Framing:

1. Stringers: Fabricate of steel plates.

a. Stringer Size: As required to comply with "Performance Requirements" Article.
b. Provide closures for exposed ends of channel and rectangular tube stringers.
c. Finish: Shop primed.

2. Platforms: Construct of steel plate headers and miscellaneous framing members as required to comply with "Performance Requirements" Article.

a. Provide closures for exposed ends of channel and rectangular tube framing.
b. Finish: Shop primed.

3. Weld or bolt stringers to headers; weld or bolt framing members to stringers and headers. If using bolts, fabricate and join so bolts are not exposed on finished surfaces.
4. Where stairs are enclosed by gypsum board shaft-wall assemblies, provide hanger rods or struts to support landings from floor construction above or below.

a. Locate hanger rods and struts where they do not encroach on required stair width and are within the fire-resistance-rated stair enclosure.

5. Where masonry walls support metal stairs, provide temporary supporting struts designed for erecting steel stair components before installing masonry.

C. Metal Pan Stairs: Form risers, subtread pans, and subplatforms to configurations shown from steel sheet of thickness needed to comply with performance requirements, but not less than 0.067 inch.

1. Steel Sheet, Uncoated: Hot-rolled steel sheet.
2. Directly weld metal pans to stringers; locate welds on top of subtreads where they will be concealed by concrete fill. Do not weld risers to stringers.
3. Attach abrasive nosings to risers.
4. Provide subplatforms of configuration indicated or, if not indicated, the same as subtreads. Weld subplatforms to platform framing.

2.8 FABRICATION OF STAIR RAILINGS AND GUARDS

A. Fabricate railings and guards to comply with requirements indicated for design, dimensions, details, finish, and member sizes, including wall thickness of member, post spacings, wall bracket spacing, and anchorage, but not less than that needed to withstand indicated loads.

B. Welded Connections: Fabricate railings and guards with welded connections.

1. Fabricate connections that are exposed to weather in a manner that excludes water.

a. Provide weep holes where water may accumulate internally.

2. Cope components at connections to provide close fit, or use fittings designed for this purpose.
3. Weld all around at connections, including at fittings.
4. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
5. Obtain fusion without undercut or overlap.
6. Remove flux immediately.
7. Finish welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Finish #1 - No evidence of a welded joint as shown in NAAMM AMP 521.

C. Form changes in direction of railings and guards as follows:

1. As detailed.

D. For changes in direction made by bending, use jigs to produce uniform curvature for each repetitive configuration required. Maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.

E. Close exposed ends of railing and guard members with prefabricated end fittings.

F. Provide wall returns at ends of wall-mounted handrails unless otherwise indicated.

1. Close ends of returns unless clearance between end of rail and wall is 1/4 inch or less.

G. Connect posts to stair framing by direct welding unless otherwise indicated.

H. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, end closures, flanges, miscellaneous fittings, and anchors for interconnecting components and for attaching to other work.

1. Furnish inserts and other anchorage devices for connecting to concrete or masonry work.
2. Provide type of bracket with flange tapped for concealed anchorage to threaded hanger bolt and that provides 1-1/2-inch clearance from inside face of handrail to finished wall surface.

I. Fillers: Provide fillers made from steel plate, or other suitably crush-resistant material, where needed to transfer wall bracket loads through wall finishes to structural supports.

1. Size fillers to suit wall finish thicknesses and to produce adequate bearing area to prevent bracket rotation and overstressing of substrate.

2.9 FINISHES

A. Finish metal stairs after assembly.

B. Preparation for Shop Priming: Prepare uncoated, ferrous-metal surfaces to comply with SSPC-SP 3, "Power Tool Cleaning."

C. Apply shop primer to uncoated surfaces of metal stair components, except those with galvanized finishes and those to be embedded in concrete or masonry unless otherwise indicated. Comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify elevations of floors, bearing surfaces and locations of bearing plates, and other embedments for compliance with requirements.

1. For wall-mounted railings, verify locations of concealed reinforcement within gypsum board assemblies.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF METAL PAN STAIRS

A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing metal stairs to in-place construction.

1. Include threaded fasteners for concrete and masonry inserts, through-bolts, lag bolts, and other connectors.

B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal stairs. Set units accurately in location, alignment, and elevation, measured from established lines and levels and free of rack.

C. Install metal stairs by welding stair framing to steel structure or to weld plates cast into concrete unless otherwise indicated.

1. Grouted Baseplates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates.

a. Clean bottom surface of plates.
b. Set plates for structural members on wedges, shims, or setting nuts.
c. Tighten anchor bolts after supported members have been positioned and plumbed.
d. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
e. Promptly pack grout solidly between bearing surfaces and plates so no voids remain.

1) Neatly finish exposed surfaces; protect grout and allow to cure.
2) Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.

D. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

E. Fit exposed connections accurately together to form hairline joints.

1. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations.
2. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.
3. Comply with requirements for welding in "Fabrication, General" Article.

F. Place and finish concrete fill for treads and platforms to comply with Section 033000 "Cast-in-Place Concrete."

1. Install abrasive nosings with anchors fully embedded in concrete.
2. Center nosings on tread width.

3.3 INSTALLATION OF RAILINGS AND GUARDS

A. Adjust railing and guard systems before anchoring to ensure matching alignment at abutting joints with tight, hairline joints.

1. Space posts at spacing indicated or, if not indicated, as required by design loads.
2. Plumb posts in each direction, within a tolerance of 1/16 inch in 3 feet.
3. Align rails and guards so variations from level for horizontal members and variations from parallel with rake of stairs for sloping members do not exceed 1/4 inch in 12 feet.
4. Secure posts, rail ends, and guard ends to building construction as follows:

a. Anchor posts to steel by welding to steel supporting members.
b. Anchor handrail and guard ends to concrete and masonry with steel round flanges welded to rail and guard ends and anchored with post-installed anchors and bolts.

B. Attach handrails to wall with wall brackets.

1. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.
2. Secure wall brackets to building construction as required to comply with performance requirements and as follows:

a. For concrete and solid masonry anchorage, use drilled-in expansion shields and hanger or lag bolts.
b. For hollow masonry anchorage, use toggle bolts.
c. For steel-framed partitions, use self-tapping screws fastened to steel framing or to concealed steel reinforcements.

3.4 REPAIR

A. Touchup Painting:

1. Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

a. Apply by brush or spray to provide a minimum 2.0-mil dry film thickness.

2. Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Section 099123 "Interior Painting."

END OF SECTION

SECTION 05 51 19 - METAL GRATING STAIRS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Metal grating stairs.
2. Steel railings and guards.

1.2 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written instructions to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of anchorages for metal stairs, railings, and guards.

1. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry.
2. Deliver such items to Project site in time for installation.

1.3 ACTION SUBMITTALS

A. Product Data: For metal grating stairs and the following:

1. Gratings.
2. Shop primer products.

B. Sustainable Design Submittals:

1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.
2. Environmental product declaration.
3. Sourcing of Raw Materials: Corporate sustainability report for each manufacturer.

C. Shop Drawings:

1. Include plans, elevations, sections, details, and attachment to other work.
2. Indicate sizes of metal sections, thickness of metals, profiles, holes, and field joints.
3. Indicate locations of anchors, weld plates, and blocking for attachment of wall-mounted handrails.

D. Delegated Design Submittal: For stairs[**, railings, and guards**], including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For professional engineer's experience with providing delegated design engineering services of the kind indicated, including documentation that engineer is licensed in the State in which Project is located.

B. Welding certificates.

C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Fabricator of products.

B. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store materials to permit easy access for inspection and identification.

1. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers.
2. Protect steel members and packaged materials from corrosion and deterioration.
3. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures.

a. Repair or replace damaged materials or structures as directed.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design stairs, railings, and guards, including attachment to building construction.

B. Structural Performance of Stairs: Metal stairs withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

1. Uniform Load: 100 lbf/sq. ft..
2. Concentrated Load: 300 lbf applied on an area of 4 sq. in..
3. Uniform and concentrated loads need not be assumed to act concurrently.
4. Stair Framing: Capable of withstanding stresses resulting from railing and guard loads in addition to loads specified above.
5. Limit deflection of treads, platforms, and framing members to L/360.

C. Structural Performance of Railings and Guards: Railings and guards, including attachment to building construction, withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

1. Handrails and Top Rails of Guards:

a. Uniform load of 50 lbf/ft. applied in any direction.
b. Concentrated load of 200 lbf applied in any direction.
c. Uniform and concentrated loads need not be assumed to act concurrently.

2. Infill of Guards:

a. Concentrated load of 50 lbf applied horizontally on an area of 1 sq. ft..
b. Infill load and other loads need not be assumed to act concurrently.

2.2 METALS

A. Metal Surfaces: Provide materials with smooth, flat surfaces unless otherwise indicated. For components exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

B. Steel Plates, Shapes, and Bars: ASTM A36/A36M.

1. Recycled Content: Provide manufacturer documentation for recycled content, indicating postconsumer and preconsumer recycled content.
2. Regional Materials: Fabricate products within 100 miles of Project site from materials that have been extracted, harvested, or recovered within 100 miles of Project site.

C. Steel Tubing for Railings and Guards: ASTM A500/A500M (cold formed).

1. Recycled Content: Provide manufacturer documentation for recycled content, indicating postconsumer and preconsumer recycled content.
2. Regional Materials: Fabricate products within 100 miles of Project site from materials that have been extracted, harvested, or recovered within 100 miles of Project site.

D. Rolled-Steel Floor Plate: ASTM A786/A786M, rolled from plate complying with ASTM A36/A36M or ASTM A283/A283M, Grade C or D.

E. Steel Bars for Grating Treads: ASTM A36/A36M or steel strip, ASTM A1011/A1011M or ASTM A1018/A1018M.

F. Steel Wire Rod for Grating Crossbars: ASTM A510/A510M.

G. Steel Tubing for Railings and Guards: ASTM A500/A500M (cold formed) or ASTM A513/A513M.

2.3 MISCELLANEOUS MATERIALS

A. Welding Electrodes: Comply with AWS requirements.

B. Shop Primers: Provide primers that comply with Section 09 91 23 "Interior Painting."

2.4 FABRICATION, GENERAL

A. Provide complete stair assemblies, including metal framing, hangers, railings, guards, clips, brackets, bearing plates, and other components necessary to support and anchor stairs and platforms on supporting structure.

1. Join components by welding unless otherwise indicated.
2. Use connections that maintain structural value of joined pieces.

B. Assemble stairs, railings, and guards in shop to greatest extent possible.

1. Disassemble units only as necessary for shipping and handling limitations.
2. Clearly mark units for reassembly and coordinated installation.

C. Cut, drill, and punch metals cleanly and accurately.

1. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated.
2. Remove sharp or rough areas on exposed surfaces.

D. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

E. Form exposed work with accurate angles and surfaces and straight edges.

F. Weld connections to comply with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. Weld exposed corners and seams continuously unless otherwise indicated.
5. At exposed connections, finish exposed welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Finish # 3 - Partially dressed weld with spatter removed.

G. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible.

1. Where exposed fasteners are required, use Phillips flat-head (countersunk) screws or bolts unless otherwise indicated.
2. Locate joints where least conspicuous.
3. Fabricate joints that are exposed to weather in a manner to exclude water.
4. Provide weep holes where water may accumulate internally.

2.5 FABRICATION OF STEEL-FRAMED STAIRS

A. NAAMM Stair Standard: Comply with NAAMM AMP 510, "Metal Stairs Manual," for Industrial Class, unless more stringent requirements are indicated.

B. Stair Framing:

1. Fabricate stringers of steel plates.

a. Stringer Size: As required to comply with "Performance Requirements" Article.
b. Finish: Shop primed.

2. Construct platforms and tread supports of steel plate or channel headers and miscellaneous framing members as required to comply with "Performance Requirements" Article.

a. Provide closures for exposed ends of channel framing.
b. Finish: Shop primed.

3. Weld stringers to headers; weld framing members to stringers and headers.

C. Metal Bar-Grating Stairs: Form treads and platforms to configurations shown from metal bar grating; fabricate to comply with NAAMM MBG 531, "Metal Bar Grating Manual."

1. Fabricate treads and platforms from welded steel grating with 1-1/2-by-3/16-inch bearing bars at 1-3/16 inch o.c. and crossbars at 4 inches o.c.

a. Surface: Serrated.
b. Finish: Shop primed.

2. Fabricate grating platforms with nosing matching that on grating treads.

a. Secure grating to platform framing by welding.

D. Risers: Solid.

E. Toe Plates: Provide toe plates around openings and at edge of open-sided floors and platforms, and at open ends and open back edges of treads.

1. Material and Finish: Steel plate to match finish of other steel items.
2. Fabricate to dimensions and details indicated.

2.6 FABRICATION OF STAIR RAILINGS AND GUARDS

A. Comply with applicable requirements in Section 05 52 13 "Pipe and Tube Railings."

2.7 FINISHES

A. Finish metal stairs after assembly.

B. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with SSPC-SP 3, "Power Tool Cleaning."

C. Apply shop primer to uncoated surfaces of metal stair components, except those with galvanized finishes and those to be embedded in concrete or masonry unless otherwise indicated. Comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.

1. Stripe paint corners, crevices, bolts, welds, and sharp edges.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify elevations of floors, bearing surfaces and locations of bearing plates, and other embedments for compliance with requirements.

1. For wall-mounted railings, verify locations of concealed reinforcement within gypsum board and plaster assemblies.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF METAL STAIRS

A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal stairs. Set units accurately in location, alignment, and elevation, measured from established lines and levels and free of rack.

B. Install metal stairs by welding stair framing to steel structure unless otherwise indicated.

C. Fit exposed connections accurately together to form hairline joints.

1. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations.
2. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.
3. Comply with requirements for welding in "Fabrication, General" Article.

3.3 REPAIR

A. Touchup Painting:

1. Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

a. Apply by brush or spray to provide a minimum 2.0-mil dry film thickness.

END OF SECTION

SECTION 05 52 13 - PIPE AND TUBE RAILINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Steel railings.

B. Related Requirements:

1. Section 05 51 13 "Metal Pan Stairs" for steel tube railings associated with metal pan stairs.
2. Section 05 51 19 "Metal Grating Stairs" for steel tube railings associated with metal pan stairs.
3. Section 05 73 00 "Decorative Metal Railings" for ornamental railings fabricated from pipes and tubes and guard-infill metals.

1.2 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of anchorages for railings. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

1.3 ACTION SUBMITTALS

A. Product Data:

1. Shop primer.

B. Sustainable Design Submittals:

1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.

C. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

D. Delegated Design Submittal: For railings, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For delegated design professional engineer.

B. Welding certificates.

C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.

1.5 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel in accordance with the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."

1.6 DELIVERY, STORAGE, AND HANDLING

A. Protect mechanical finishes on exposed surfaces of railings from damage by applying a strippable, temporary protective covering before shipping.

1.7 FIELD CONDITIONS

A. Field Measurements: Verify actual locations of walls and other construction contiguous with railings by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design railings, including attachment to building construction.

B. Structural Performance: Railings, including attachment to building construction, withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

1. Handrails and Top Rails of Guards:

a. Uniform load of 50 lbf/ ft. applied in any direction.
b. Concentrated load of 200 lbf applied in any direction.
c. Uniform and concentrated loads need not be assumed to act concurrently.

2. Infill of Guards:

a. Concentrated load of 50 lbf applied horizontally on an area of 1 sq. ft..
b. Infill load and other loads need not be assumed to act concurrently.

2.2 METALS, GENERAL

A. Metal Surfaces, General: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.

B. Brackets, Flanges, and Anchors: Cast or formed metal of same type of material and finish as supported rails unless otherwise indicated.

2.3 STEEL RAILINGS

A. Recycled Content of Steel Products: Provide products with postconsumer recycled content plus one-half of preconsumer recycled content to the extent required to comply with the minimum criteria specified in Section 01 81 13.14 “Sustainable Design Requirements.”

B. Tubing: ASTM A500/A500M (cold formed) or ASTM A513/A513M, Type 5.

C. Pipe: ASTM A53/A53M, Type F or Type S, Grade A, Standard Weight (Schedule 40), unless another grade and weight are required by structural loads.

D. Plates, Shapes, and Bars: ASTM A36/A36M.

E. Cast Iron Fittings: Either gray iron, ASTM A48/A48M, or malleable iron, ASTM A47/A47M, unless otherwise indicated.

2.4 FASTENERS

A. Fastener Materials:

1. Ungalvanized-Steel Railing Components: Plated steel fasteners complying with ASTM F1941/F1941M, Class Fe/Zn 5 for zinc coating.

B. Fasteners for Anchoring Railings to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings to other types of construction and capable of withstanding design loads.

2.5 MISCELLANEOUS MATERIALS

A. Welding Rods and Bare Electrodes: Select in accordance with AWS specifications for metal alloy welded.

B. Shop Primers: Provide primers that comply with Section 09 91 23 "Interior Painting."

2.6 FABRICATION

A. General: Fabricate railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage, but not less than that required to support structural loads.

B. Shop assemble railings to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations.

1. Clearly mark units for reassembly and coordinated installation.
2. Use connections that maintain structural value of joined pieces.

C. Cut, drill, and punch metals cleanly and accurately.

1. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated.
2. Remove sharp or rough areas on exposed surfaces.

D. Form work true to line and level with accurate angles and surfaces.

E. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items.

F. Connections: Fabricate railings with welded connections unless otherwise indicated.

G. Welded Connections: Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove flux immediately.
4. At exposed connections, finish exposed welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Finish #2 welds; good appearance, completely sanded joint, some undercutting and pinholes okay.

H. Form changes in direction as follows:

1. As detailed.

I. Bend members in jigs to produce uniform curvature for each configuration required. Maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.

J. Close exposed ends of hollow railing members with prefabricated cap and end fittings of same metal and finish as railings.

K. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect railing members to other work unless otherwise indicated.

L. Toe Boards: Where indicated, provide toe boards at railings around openings and at edge of open-sided floors and platforms. Fabricate to dimensions and details indicated.

2.7 STEEL AND IRON FINISHES

A. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with SSPC-SP 3.

B. Primer Application: Apply shop primer to prepared surfaces of railings unless otherwise indicated. Comply with requirements in SSPC-PA 1 for shop painting.

1. Shop prime uncoated railings with primers specified in Section 09 91 23 "Interior Painting" unless indicated.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Perform cutting, drilling, and fitting required for installing railings.

1. Fit exposed connections together to form tight, hairline joints.
2. Install railings level, plumb, square, true to line; without distortion, warp, or rack.
3. Set railings accurately in location, alignment, and elevation; measured from established lines and levels.
4. Set posts plumb within a tolerance of 1/16 inch in 3 feet.
5. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet.

B. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

C. Adjust railings before anchoring to ensure matching alignment at abutting joints.

D. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing railings and for properly transferring loads to in-place construction.

3.2 RAILING CONNECTIONS

A. Welded Connections: Use fully welded joints for permanently connecting railing components. Comply with requirements for welded connections in "Fabrication" Article, whether welding is performed in the shop or in the field.

3.3 ANCHORING POSTS

A. Anchor posts to metal surfaces with flanges, angle type, or floor type, as required by conditions, connected to posts and to metal supporting members as follows:

1. For steel railings, weld flanges to post and bolt to metal supporting surfaces.

3.4 ATTACHING RAILINGS

A. Anchor railing ends to metal surfaces with flanges bolted to metal surfaces and welded to railing ends.

3.5 REPAIR

A. Touchup Painting:

1. Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

a. Apply by brush or spray to provide a minimum 2.0-mil dry film thickness.

3.6 CLEANING

A. Clean by washing thoroughly with clean water and soap and rinsing with clean water.

3.7 PROTECTION

A. Protect finishes of railings from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at time of Substantial Completion.

B. Restore finishes damaged during installation and construction period, so no evidence remains of correction work. Return items that cannot be refinished in the field to the shop; make required alterations and refinish entire unit, or provide new units.

END OF SECTION

SECTION 05 53 13 - BAR GRATINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Metal bar gratings.
2. Grating frames and supports.

B. Related Requirements:

1. Section 05 12 00 "Structural Steel Framing" for structural-steel framing system components.
2. Section 05 51 19 "Metal Grating Stairs" for grating treads and landings of steel-framed stairs.
3. Section 05 52 13 "Pipe and Tube Railings" for metal pipe and tube handrails and railings.

1.2 ACTION SUBMITTALS

A. Product Data:

1. Clips and anchorage devices for gratings.
2. Paint products.
3. Manufacturers' published load tables.

B. Shop Drawings:

1. Include plans, sections, and attachment details.

1.3 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry.

B. Certificates:

1. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers certifying that shop primers are compatible with topcoats.
2. Welding certificates.

1.4 QUALITY ASSURANCE

A. Qualifications:

1. Welding Qualifications: Qualify procedures and personnel in accordance with the following welding codes:

    a. AWS D1.1/D1.1M.

1.5 FIELD CONDITIONS

A. Field Measurements: Verify actual locations of walls and other construction contiguous with gratings by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. All American Grating.
2. IKG.
3. McNichols C..
4. Ohio Gratings, Inc.

2.2 PERFORMANCE REQUIREMENTS

A. Structural Performance: Gratings to withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

1. Walkways and Elevated Platforms Other Than Exits: Uniform load of 60 lbf/sq. ft. (2.87 kN/sq. m).
2. Walkways and Elevated Platforms Used as Exits: Uniform load of 100 lbf/sq. ft. (4.79 kN/sq. m).
3. Limit deflection to L/360 or 1/4 inch (6.4 mm), whichever is less.

2.3 METAL BAR GRATINGS

A. Metal Bar Grating Standards: Comply with NAAMM MBG 531.

B. Welded Steel Grating:

1. Grating Mark W-19-4 (1-1/2 x 3/16) STEEL: 1-1/2-by-3/16-inch (38-by-4.8-mm) bearing bars at 1-3/16 inches (30 mm) o.c., and crossbars at 4 inches (102 mm) o.c.
2. Traffic Surface: Serrated.
3. Steel Finish: Shop primed.

2.4 GRATING FRAMES AND SUPPORTS

A. Fabricate from metal shapes, plates, and bars of welded construction to sizes, shapes, and profiles indicated and as necessary to receive gratings. Miter and weld connections for perimeter angle frames. Cut, drill, and tap units to receive hardware and similar items.

1. Unless otherwise indicated, fabricate from same basic metal as gratings.
2. Equip units indicated to be cast into concrete or built into masonry with integrally welded anchors. Unless otherwise indicated, space anchors 24 inches (600 mm) o.c. and provide minimum anchor units in the form of steel straps 1-1/4 inches (32 mm) wide by 1/4 inch (6 mm) thick by 8 inches (200 mm) long.

B. Galvanize steel frames and supports in the following locations:

1. Exterior.
2. Interior, where indicated.

2.5 FASTENERS

A. General: Unless otherwise indicated, provide Type 304 stainless steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.

1. Provide stainless steel fasteners for fastening aluminum.
2. Provide stainless steel fasteners for fastening stainless steel.

B. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A307, Grade A (ISO 898-1, Property Class 4.6); with hex nuts, ASTM A563 (ASTM A563M), and, where indicated, flat washers.

2.6 MISCELLANEOUS MATERIALS

A. Shop Primers: Provide primers that comply with Section 09 96 00 "High-Performance Coatings."

B. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.

1. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.

C. Epoxy Zinc-Rich Primer: Complying with MPI#20 and compatible with topcoat.

D. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.

E. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.

2.7 FERROUS METALS

A. Steel Plates, Shapes, and Bars: ASTM A36/A36M.

B. Steel Bars for Bar Gratings: ASTM A36/A36M or steel strip, ASTM A1011/A1011M or ASTM A1018/A1018M.

C. Wire Rod for Bar Grating Crossbars: ASTM A510/A510M.

D. Uncoated Steel Sheet: ASTM A1011/A1011M, structural steel, Grade 30 (Grade 205).

E. Galvanized-Steel Sheet: ASTM A653/A653M, structural quality, Grade 33 (Grade 230), with G90 (Z275) coating.

F. Stainless Steel Sheet, Strip, Plate, and Flat Bars: ASTM A240/A240M, Type 304.

G. Stainless Steel Bars and Shapes: ASTM A276/A276M, Type 304.

2.8 FABRICATION

A. Shop Assembly: Fabricate grating sections in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.

B. Cut, drill, and punch material cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm) unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

C. Form from materials of size, thickness, and shapes indicated, but not less than that needed to support indicated loads.

D. Fit exposed connections accurately together to form hairline joints.

E. Welding: Comply with AWS recommendations and the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.

F. Provide for anchorage of type indicated; coordinate with supporting structure. Fabricate and space the anchoring devices to secure gratings, frames, and supports rigidly in place and to support indicated loads.

1. Fabricate toeplates to fit grating units and weld to units in shop unless otherwise indicated.
2. Fabricate toeplates for attaching in the field.
3. Toeplate Height: 4 inches (100 mm) unless otherwise indicated.

G. Removable Grating Sections: Fabricate with banding bars attached by welding to entire perimeter of each section. Include anchors and fasteners of type indicated or, if not indicated, as recommended by manufacturer for attaching to supports.

1. Provide no fewer than four weld lugs for each grating section containing rectangular bearing bars 3/16 inch (4.8 mm) or less in thickness and spaced less than 15/16 inch (24

mm) o.c., with each lug shop welded to three or more bearing bars. Interrupt intermediate bearing bars as necessary for fasteners securing grating to supports.

2. Furnish threaded bolts with nuts and washers for securing grating to supports.
3. Furnish self-drilling fasteners with washers for securing grating to supports.

H. Fabricate cutouts in grating sections for penetrations indicated. Arrange cutouts to permit grating removal without disturbing items penetrating gratings.

1. Edge-band openings in grating that interrupt four or more bearing bars with bars of same size and material as bearing bars.

I. Do not notch bearing bars at supports to maintain elevation.

2.9 STEEL FINISHES

A. Finish gratings, frames, and supports after assembly.

B. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A153/A153M for steel and iron hardware and with ASTM A123/A123M for other steel and iron products.

1. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.

C. Shop prime gratings, frames, and supports not indicated to be galvanized unless otherwise indicated.

D. Preparation for Shop Priming: Prepare surfaces to comply with SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."

E. Shop Priming: Apply shop primer to comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing gratings to in-place construction. Include threaded fasteners for concrete and masonry inserts, through-bolts, lag bolts, and other connectors.

B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing gratings. Set units accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.

C. Provide temporary bracing or anchors in formwork for items that are to be built into concrete or masonry.

D. Fit exposed connections accurately together to form hairline joints.

1. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade the surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.

E. Attach toeplates to gratings by welding at locations indicated.

F. Field Welding: Comply with AWS recommendations and the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.

3.2 INSTALLATION OF METAL BAR GRATINGS

A. Install gratings to comply with recommendations of referenced metal bar grating standards that apply to grating types and bar sizes indicated, including installation clearances and standard anchoring details.

B. Attach removable units to supporting members with type and size of clips and fasteners indicated or, if not indicated, as recommended by grating manufacturer for type of installation conditions shown.

C. Attach nonremovable units to supporting members by welding where both materials are same; otherwise, fasten by bolting as indicated above.

3.3 REPAIR

A. Repair Painting:

1. Wire brush and clean rust spots, welds, and abraded areas on prime-painted gratings immediately after installation, and apply repair paint with same material as used for shop painting to comply with SSPC-PA 1 requirements for touching up shop-painted surfaces.

a. Apply by brush or spray to provide a minimum 2.0-mil (0.05-mm) dry film thickness.

2. Wire brushing, cleaning, and repair painting of rust spots, welds, and abraded areas of both deck surfaces are included in Section 09 96 00 "High Performance Coatings."

B. Repair of Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A780/A780M.

END OF SECTION

SECTION 05 58 13 - COLUMN COVERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes snap-together metal column covers.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product, including finishing materials.

B. Shop Drawings: Show fabrication and installation details for column covers.

C. Samples for Initial Selection: For products involving selection of color, texture, or design, including mechanical finishes.

D. Samples for Verification: For each type of exposed finish required, prepared on 6-inch-square Samples of metal of same thickness and material indicated for the Work.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For fabricator.

1.4 QUALITY ASSURANCE

A. Fabricator Qualifications: A firm experienced in producing column covers similar to that indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver column covers wrapped in protective coverings and strapped together in suitable packs or in heavy-duty cartons. Remove protective coverings before they stain or bond to finished surfaces.

PART 2 - PRODUCTS

2.1 SNAP-TOGETHER COLUMN COVERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide **Forms+Surfaces; LEVELc Column System** or a comparable product by one of the following:

1. Gordon Incorporated.
2. Ceilings Plus.
3. Fry Reglet Corporation.
4. MM Systems Corporation.
5. Pittcon Industries.
6. Southwest Metalsmiths, Inc.

B. Form column covers to shapes indicated from metal of type and minimum thickness indicated below. Return vertical edges and bend to form hook that engages continuous mounting clips.

1. Bronze Sheet: ASTM B36/B36M, Alloy UNS C28000 (muntz metal, 60 percent copper), 0.051 inch thick.

a. Finish: Satin.

2. Column covers fabricated from prefinished metal sheet with all unfinished edges concealed from view.
3. Increase metal thickness or reinforce with concealed stiffeners, backing materials, or both, as needed to provide flat surfaces where indicated.
4. Support joints with concealed stiffeners as needed to hold exposed faces of adjoining sheets in flush alignment.
5. Form returns at vertical joints to provide hairline V-joints.
6. Fabricate column covers without horizontal joints.
7. Fabricate base ring to match column covers.
8. Apply manufacturer's recommended sound-deadening mastic to backs of column covers.

2.2 MISCELLANEOUS MATERIALS

A. Fasteners: Fabricated from same basic metal and alloy as fastened metal unless otherwise indicated. Do not use metals that are incompatible with materials joined.

1. Provide concealed fasteners for interconnecting column covers and for attaching them to other work.

B. Sound-Deadening Materials:

1. Mastic: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.

C. Backing Materials: Provided or recommended by column cover manufacturer.

2.3 FABRICATION, GENERAL

A. Coordinate dimensions and attachment methods of column covers with those of adjoining construction to produce integrated assemblies with closely fitting joints and with edges and surfaces aligned unless otherwise indicated.

B. Form metal to profiles indicated, in maximum lengths to minimize joints. Produce flat, flush surfaces without cracking or grain separation at bends.

2.4 GENERAL FINISH REQUIREMENTS

A. Complete mechanical finishes of flat sheet metal surfaces before fabrication where possible. After fabrication, finish all joints, bends, abrasions, and other surface blemishes to match sheet finish.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.5 COPPER-ALLOY FINISHES

A. Hand-Rubbed Finish, Lacquered: M31-M34-O6x (Mechanical Finish: directionally textured, fine satin; Mechanical Finish: directionally textured, hand rubbed; Coating: clear, organic, air dried, as specified below).

1. Clear, Organic Coating: Lacquer specified for copper alloys, applied by air spray in two coats per manufacturer's written instructions, with interim drying, to a total thickness of 1 mil.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of column covers.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Locate and place column covers plumb and in alignment with adjacent construction. Perform cutting, drilling, and fitting required to install column covers.

1. Do not cut or abrade finishes that cannot be completely restored in the field. Return items with such finishes to the shop for required alterations, followed by complete refinishing, or provide new units as required.

B. Use concealed anchorages where possible.

C. Form tight joints accurately fitted together.

D. Corrosion Protection: Apply bituminous paint or other permanent separation materials on concealed surfaces where metals would otherwise be in direct contact with substrate materials that are incompatible or could result in corrosion or deterioration of either material or finish.

3.3 ADJUSTING AND CLEANING

A. Restore finishes damaged during installation and construction period so no evidence remains of correction work. Return items that cannot be refinished in the field to the shop; make required alterations and refinish entire unit or provide new units.

3.4 PROTECTION

A. Protect finishes from damage during construction period. Remove temporary protective coverings at time of Substantial Completion.

END OF SECTION

SECTION 05 70 00 - DECORATIVE METAL

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Decorative mechanical grilles and frames.
2. Decorative metal laylight framing.

B. Related Requirements:

1. Section 08 81 13 “Decorative Glass Glazing” for glazing installed in custom decorative metal laylight framing.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product, including finishing materials.

B. Sustainable Design Submittals:

1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.

C. Shop Drawings: Show fabrication and installation details for decorative metal.

1. Include plans, elevations, component details, attachment, and support details.
2. Indicate materials and profiles of each decorative metal member, fittings, joinery, finishes, fasteners, anchorages, and accessory items.

D. Samples for Verification: For each type of exposed finish and pattern.

1. Sections of mechanical grilles:

a. Courtroom grille: Full-size Sample.
b. Baseboard grille: Full width by 18-inch-long Sample

2. Laylight framing members: Full size sample including curved main framing member and intersection of radial member. Curved member to be a minimum of 2 feet long and include a splice; straight radial member to be a minimum of 1 foot long.

E. Delegated Design Submittal: For laylight framing system and supports indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For fabricator.

1.4 QUALITY ASSURANCE

A. Fabricator Qualifications: A firm experienced in producing decorative metal similar to that indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store decorative metal in a well-ventilated area, away from uncured concrete and masonry, and protected from weather, moisture, soiling, abrasion, extreme temperatures, and humidity.

1.6 FIELD CONDITIONS

A. Field Measurements: Verify actual locations of walls and other construction contiguous with decorative metal by field measurements before fabrication and indicate measurements on Shop Drawings.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design decorative metal laylight framing, including support of and attachment to building construction.

B. Structural Performance of Laylight: Laylight to withstand the effects of gravity loads from self-weight and that of decorative glass glazing and the following live loads:

1. Uniform load of 10 lbf./sq. ft.
2. Concentrated load of 200 lb. at each framing intersection with no more than four locations loaded concurrently.
3. Design and locate hangers to limit laylight deflection of framing members to not greater than 1/4 inch between hanger locations.

2.2 METALS, GENERAL

A. Metal Surfaces, General: Use materials with smooth, flat surfaces unless otherwise indicated. Use materials without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.

2.3 ALUMINUM

A. Fabricate products from alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with strength and durability properties for each aluminum form required not less than that of alloy and temper designated below.

B. Bars and Shapes: ASTM B221, Alloy 6063-T5/T52.

C. Plate and Sheet: ASTM B209, Alloy 6061-T6.

2.4 BRONZE

A. Plate, Sheet, Strip, and Bars: ASTM B36/B36M, Alloy UNS C28000 (muntz metal, 60 percent copper).

2.5 FASTENERS

A. Fastener Materials: Unless otherwise indicated, provide the following:

1. Aluminum Items: Type 304 stainless steel fasteners.
2. Copper-Alloy (Bronze) Items: Silicon bronze (Alloy 651 or Alloy 655) fasteners where concealed, muntz metal (Alloy 280) fasteners where exposed.

B. Fasteners for Anchoring to Other Construction: Unless otherwise indicated, select fasteners of type, grade, and class required to produce connections suitable for anchoring indicated items to other types of construction indicated.

C. Provide concealed fasteners for interconnecting components and for attaching decorative metal items to other work unless otherwise indicated.

1. Provide Phillips flat-head machine screws for exposed fasteners where indicated.

2.6 MISCELLANEOUS MATERIALS

A. Lacquer for Copper Alloys: Clear, acrylic lacquer specially developed for coating copper-alloy products.

B. Miscellaneous Hanging Accessories: For decorative metal laylight support, include hanger wires, threaded rods, wire rope, eyehooks, turnbuckles, and fittings of size and material determined by delegated design and approved by Architect in Shop Drawings.

2.7 FABRICATION, GENERAL

A. Assemble items in the shop to greatest extent possible to minimize field splicing and assembly.

1. Disassemble units only as necessary for shipping and handling limitations.
2. Clearly mark units for reassembly and coordinated installation.
3. Use connections that maintain structural value of joined pieces.

B. Form decorative metal to required shapes and sizes, true to line and level with true curves and accurate angles and surfaces. Finish exposed surfaces to smooth, sharp, well-defined lines and arris.

C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing the Work.

D. Cut, drill, mill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

E. Mill joints to a tight, hairline fit. Cope or miter corner joints.

F. Mill bar stock to profiles indicated providing smooth flat surfaces where exposed to view.

G. If required by indicated geometry, waterjet cut bar and plate to configurations indicated.

H. Provide necessary rebates, lugs, and brackets to assemble units and to attach to other work. Cut, reinforce, drill, and tap as needed to receive finish hardware, screws, and similar items unless otherwise indicated.

2.8 DECORATIVE MECHANICAL GRILLES

A. Basis-of-Design Product: Subject to compliance with requirements, provide **Architectural Grille; 204 Clover Leaf** or a comparable product by one of the following:

1. DLSS Manufacturing.
2. H&K Perforating LLC.
3. Precision Metal Fabricators, Inc.
4. Reggio Register Company, Inc.
5. Register & Grille Mfg. Co., Inc.

B. Fabricate decorative grilles from perforated bronze sheet or plate of thickness, size, and pattern indicated. Form perforations by punching, cutting, drilling or water-jet cutting to produce openings of sizes and shapes indicated. Roll, press, and grind perforated metal to flatten and to remove burrs and deformations.

1. Thickness: 1/8 inch.
2. Perforation Pattern: Cloverleaf No. 204, 1/2 by 3/16 inch pattern, 51 percent open, as indicated by basis-of-design manufacturer’s designation.
3. Perforated metal patterns produced by other manufacturers may be considered, provided deviations are minor and do not change design concept as judged solely by Architect.

C. Drill and countersink grilles for mounting screws at 2 inches from corners and at 10 inches or less o.c. Provide units with self-tapping machine screws.

2.9 DECORATIVE LAYLIGHT FRAMING

A. Fabricate decorative laylight framing to designs indicated from aluminum bars and shapes of sizes and profiles indicated. Form aluminum bars by bending, coping, mitering, milling, and/or waterjet cutting, as required.

B. Brackets, Fittings, and Anchors: Provide brackets, fittings, hangers, and anchors to connect decorative laylight framing to other work as indicated.

1. Fabricate anchorage devices that are capable of withstanding loads indicated.

C. Finish: After fabrication as follows:

1. Exposed to view surfaces and members: Baked-enamel or powder-coat.
2. Concealed surfaces: Mill finish.

2.10 FINISHES, GENERAL

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

2.11 ALUMINUM FINISHES

A. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.

B. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of 1.5 mils. Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

1. Color and Gloss: As preselected and indicated in Finish Schedule.

2.12 COPPER-ALLOY FINISHES

A. Finish designations for copper alloys comply with the system established for designating copper-alloy finish systems defined in NAAMM's "Metal Finishes Manual for Architectural and Metal Products."

B. Hand-Rubbed Finish, Lacquered: M31-M34-O6x (Mechanical Finish: directionally textured, fine satin; Mechanical Finish: directionally textured, hand rubbed; Coating: clear, organic, air dried, as specified below):

1. Clear, Organic Coating: Lacquer specified for copper alloys; applied by air spray in two coats per manufacturer's written instructions, with interim drying, to a total thickness of 1 mil.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of decorative metal.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Provide anchorage devices, hangers, and fasteners where needed to secure decorative metal to in-place construction.

B. Perform cutting, drilling, and fitting required to install decorative metal. Set products accurately in location, alignment, and elevation, measured from established lines and levels.

C. Fit exposed connections accurately together to form tight, hairline joints. Where cutting, welding, and grinding are required for proper shop fitting and jointing of decorative metal, restore finishes to eliminate evidence of such corrective work.

D. Do not cut or abrade finishes that cannot be completely restored in the field. Return items with such finishes to the shop for required alterations, followed by complete refinishing, or provide new units as required.

E. Restore protective coverings that have been damaged during shipment or installation. Remove protective coverings only when there is no possibility of damage from other work yet to be performed at same location.

1. Retain protective coverings intact; remove coverings simultaneously from similarly finished items to preclude nonuniform oxidation and discoloration.

F. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

3.3 INSTALLATION OF DECORATIVE MECHANICAL GRILLES

A. Mount decorative grilles at heights and in positions indicated, adjusting ductwork, if any, to be centered on grilles.

1. Secure to framing and blocking with specified fasteners.
2. Provide frame of type indicated.

3.4 INSTALLATION OF DECORATIVE METAL LAYLIGHT FRAMING

A. Suspend decorative metal laylight from building’s structural members as indicated and approved on Shop Drawings.

B. Secure hangers to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices that are secure and appropriate for both the structure to which hangers are attached and the type of hanger involved. Install hangers in a manner that will not cause them to deteriorate or fail due to age, corrosion, or elevated temperatures.

C. Erection Tolerances: Install decorative metal laylight framing level to a tolerance of 1/8 inch in 12 feet, non-cumulative.

3.5 CLEANING AND PROTECTION

A. Unless otherwise indicated, clean metals by washing thoroughly with clean water and soap, rinsing with clean water, and drying with soft cloths.

B. Clean copper alloys according to metal finisher's written instructions in a manner that leaves an undamaged and uniform finish matching approved Sample.

C. Protect finishes of decorative metal from damage during construction period with temporary protective coverings approved by decorative metal fabricator. Remove protective covering at time of Substantial Completion.

D. Restore finishes damaged during installation and construction period so no evidence remains of correction work. Return items that cannot be refinished in the field to the shop; make required alterations and refinish entire unit, or provide new units.

END OF SECTION

This page is intentionally left blank.

SECTION 05 71 00 - DECORATIVE METAL STAIRS

PART 1 - GENERAL

1.1 SUMMARY

A. Description of Work: Work includes fabrication, delegated design, and installation of custom decorative metal stairs comprised of steel stringers, precast terrazzo treads and risers, custom guardrails and handrails, and finished gypsum board soffits in configuration indicated on the Drawings.

B. Section includes decorative metal stairs complete.

C. Related Requirements:

1. Section 05 73 00 “Decorative Metal Railings” for fabrication and installation of metal guards and rails associated with decorative metal stairs.
2. Section 09 66 23 “Resinous Matrix Terrazzo Flooring” for thin-set, epoxy-resin terrazzo flooring and precast epoxy-resin terrazzo units.

1.2 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written instructions to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of anchorages for metal stairs.

1. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry.
2. Deliver such items to Project site in time for installation.

1.3 ACTION SUBMITTALS

A. Product Data: For metal stairs and the following:

1. Shop primer products.
2. Precast terrazzo treads.
3. Grout.

B. Sustainable Design Submittals:

1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.
2. Environmental product declaration.

C. Shop Drawings:

1. Include plans, elevations, sections, details, and attachments to other work.
2. Indicate sizes of metal sections, thickness of metals, profiles, holes, and field joints.
3. Include plan at each level.

D. Samples for Verification: For each type and finish of tread.

E. Delegated Design Submittal: For stairs, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For professional engineer's experience with providing delegated design engineering services of the kind indicated, including documentation that the engineer is licensed in the State in which Project is located.

B. Welding certificates.

C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Fabricator of products.

B. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store materials to permit easy access for inspection and identification.

1. Keep members off ground and spaced by using pallets, dunnage, or other supports and spacers.
2. Protect members and packaged materials from corrosion and deterioration.
3. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures.

a. Repair or replace damaged materials or structures as directed.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design stairs, and railings, including attachment to building construction.

B. Structural Performance of Stairs: Metal stairs withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

1. Uniform Load: 100 lbf/sq. ft..
2. Concentrated Load: 300 lbf applied on an area of 4 sq. in..
3. Uniform and concentrated loads need not be assumed to act concurrently.
4. Stair Framing: Capable of withstanding stresses resulting from railing loads in addition to loads specified above.
5. Limit deflection of treads, platforms, and framing members to L/360 or 1/2 inch for total load deflection, and L/540 or 1/4 inch for live load deflection, whichever is less.
6. Vibration Criteria for Monumental Stairs:

    a. Design according to AISC Steel Design Guide 11, Second Edition, except as follows.

        1) Criterion for rapidly descending group need not apply.

    b. Acceleration: Maximum acceleration not to exceed 1.7%g.
    c. Vibration criteria shall be based on a 92-lb concentrated load and a damping ratio of 0.01.
    d. Design built up stringer section as required to meet performance criteria.

        1) Maximum stringer depths shall not exceed depth available in architectural sections

2.2 METALS

A. Metal Surfaces: Provide materials with smooth, flat surfaces unless otherwise indicated. For components exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

B. Steel Plates, Shapes, and Bars: ASTM A36/A36M.

1. Recycled Content: Provide products with postconsumer recycled content plus one-half of preconsumer recycled content to the extent required to comply with the minimum criteria specified in Section 01 81 13.14 “Sustainable Design Requirements.”

C. Steel Tubing: ASTM A500/A500M (cold formed) or ASTM A513/A513M.

1. Recycled Content: Provide products with postconsumer recycled content plus one-half of preconsumer recycled content to the extent required to comply with the minimum criteria specified in Section 01 81 13.14 “Sustainable Design Requirements.”

D. Uncoated, Hot-Rolled Steel Sheet: ASTM A1011/A1011M, either commercial steel, Type B, or structural steel, Grade 30, unless another grade is required by design loads.

1. Recycled Content: Provide products with postconsumer recycled content plus one-half of preconsumer recycled content to the extent required to comply with the minimum criteria specified in Section 01 81 13.14 “Sustainable Design Requirements.”

E. Bronze Sheet: ASTM B36/B36M, Alloy UNS C28000 (muntz metal, 60 percent copper).

F. Bronze Extrusions: ASTM B455, Alloy UNS No. C38500 (extruded architectural bronze) to match bronze sheet.

2.3 FASTENERS

A. General: Provide zinc-plated fasteners with coating complying with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5 where built into exterior walls.

1. Select fasteners for type, grade, and class required.

B. Bolts and Nuts: Regular hexagon-head bolts, ASTM A307, Grade A; with hex nuts, ASTM A563; and, where indicated, flat washers.

C. Anchor Bolts: ASTM F1554, Grade 36, of dimensions indicated; with nuts, ASTM A563; and, where indicated, flat washers.

1. Provide mechanically deposited or hot-dip, zinc-coated anchor bolts for stairs indicated to be shop primed with zinc-rich primer.

D. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E488/E488M, conducted by a qualified independent testing agency.

1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, unless otherwise indicated.

2.4 MISCELLANEOUS MATERIALS

A. Welding Electrodes: Comply with AWS requirements.

B. Shop Primers: Provide primers that comply with Section 09 96 00 "High-Performance Coatings."

C. Nonmetallic, Shrinkage-Resistant Grout: ASTM C1107/C1107M, factory-packaged, nonmetallic aggregate grout; recommended by manufacturer for interior use; noncorrosive and nonstaining; mixed with water to consistency suitable for application and a 30-minute working time.

2.5 PRECAST TERRAZZO TREADS

A. Precast Terrazzo Stair Treads: Epoxy terrazzo units cast in maximum lengths possible as specified in Section 09 66 23 “Resinous Matrix Terrazzo Flooring.” Comply with manufacturer's written instructions for fabricating precast terrazzo units in sizes and profiles indicated.

2.6 FABRICATION, GENERAL

A. Provide complete stair assemblies, including metal framing, hangers, struts, clips, brackets, bearing plates, and other components necessary to support and anchor stairs and platforms on supporting structure.

1. Join components by welding unless otherwise indicated.
2. Use connections that maintain structural value of joined pieces.

B. Assemble stairs in shop to greatest extent possible.

1. Disassemble units only as necessary for shipping and handling limitations.
2. Clearly mark units for reassembly and coordinated installation.

C. Cut, drill, and punch metals cleanly and accurately.

1. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated.
2. Remove sharp or rough areas on exposed surfaces.

D. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

E. Form exposed work with accurate angles and surfaces and straight edges.

F. Weld connections to comply with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. Weld exposed corners and seams continuously unless otherwise indicated.
5. At exposed connections, finish exposed welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Finish #1 - No evidence of a welded joint.

G. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible.

1. Where exposed fasteners are required, use Phillips flat-head (countersunk) screws or bolts unless otherwise indicated.
2. Locate joints where least conspicuous.

2.7 FABRICATION OF STAIRS

A. NAAMM Stair Standard: Comply with NAAMM AMP 510, "Metal Stairs Manual," for Architectural Class, unless more stringent requirements are indicated.

B. Stair Framing:

1. Stringers: Fabricate of steel tubes as indicated on Drawings.

   a. Stringer Size: As indicated on Drawing and as required to comply with "Performance Requirements" Article.
   b. Provide closures for exposed ends of tube stringers.
   c. Finish: Shop primed.

2. Platforms: Construct of steel rectangular tube headers and miscellaneous framing members as required to comply with "Performance Requirements" Article and as indicated on Drawings.

   a. Provide closures for exposed ends of tube framing.
   b. Finish: Shop primed.

3. Weld stringers to headers; weld framing members to stringers and headers.

C. Subtreads, Risers, and Subplatforms:

1. Form subtreads, risers, and subplatforms to configurations indicated from uncoated, hot-rolled steel sheet of thickness needed to comply with performance requirements, but not less than 0.075 inch thick.
2. Weld subtreads to stringers.

   a. Locate welds on top of subtreads where they will be concealed by finished treads.

3. Provide subplatforms of configuration indicated or, if not indicated, the same as subtreads.

   a. Weld subplatforms to platform framing.
   b. Locate welds on top of subplatforms where they will be concealed by finished flooring.

2.8 STAIR RAILINGS

A. Comply with applicable requirements in Section 05 73 00 "Decorative Metal Railings."

1. Connect posts to stair framing by direct welding unless otherwise indicated.

2.9 FINISHES

A. Finish metal stairs after assembly.

B. Steel Shop Prime Finish:

1. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
2. Apply shop primer to uncoated surfaces of metal stair components, except those with galvanized finishes and those to be embedded in concrete or masonry unless otherwise indicated. Comply with SSPC-PA 1, "Shop, Field, and Maintenance Painting of Steel," for shop painting.

    a. Stripe paint corners, crevices, bolts, welds, and sharp edges.

C. Bronze Finishes:

1. Hand-Rubbed Finish, Lacquered: CDA M31-M34-O6x (Mechanical Finish: directionally textured, fine satin; Mechanical Finish: directionally textured, hand rubbed; Coating: clear, organic, air dried, as specified below).

    a. Clear, Organic Coating: Lacquer specified for copper alloys, applied by air spray in two coats per manufacturer's written instructions, with interim drying, to a total thickness of 1 mil.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify elevations of floors, bearing surfaces and locations of bearing plates, and other embedments for compliance with requirements.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLING METAL STAIRS

A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing metal stairs to in-place construction.

1. Include threaded fasteners for concrete and masonry inserts, through-bolts, lag bolts, and other connectors.

B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal stairs. Set units accurately in location, alignment, and elevation, measured from established lines and levels and free of rack.

C. Install metal stairs by welding stair framing to steel structure or to weld plates cast into concrete unless otherwise indicated.

1. Grouted Baseplates: Clean concrete-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates.

    a. Clean bottom surface of plates.
    b. Set plates for structural members on wedges, shims, or setting nuts.
    c. Tighten anchor bolts after supported members have been positioned and plumbed.

d. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
e. Promptly pack grout solidly between bearing surfaces and plates so no voids remain.

1) Neatly finish exposed surfaces; protect grout and allow to cure.
2) Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.

D. Provide temporary bracing or anchors in formwork for items that are to be built into concrete or masonry.

E. Fit exposed connections accurately together to form hairline joints.

1. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations.
2. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.
3. Field Welding: Comply with requirements for welding in "Fabrication, General" Article.

F. Place and finish concrete fill for platforms to comply with Section 033000 "Cast-in-Place Concrete."

G. Install precast terrazzo treads according to manufacturer's written instructions.

3.3 REPAIRS

A. Touchup Painting:

1. Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

a. Apply by brush or spray to provide a minimum 2.0-mil dry film thickness.

END OF SECTION

SECTION 05 73 00 - DECORATIVE METAL RAILINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Description of Work: Work includes delegated design and fabrication of custom guardrails and handrails comprised of powder-coated steel bar balustrade and brass rails in configuration indicated on the Drawings.

B. Section Includes:

1. Steel and iron decorative railings with copper-alloy rails as indicated.

1.2 COORDINATION AND SCHEDULING

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written instructions to ensure that shop primers and topcoats are compatible.

B. Coordinate installation of anchorages for railings. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver items to Project site in time for installation.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data:

1. Manufacturer's product lines of decorative metal railings.
2. Fasteners.
3. Handrail brackets.
4. Lacquer for copper alloys.

B. Sustainable Design Submittals:

1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.

C. Shop Drawings: Include plans, elevations, sections, and attachment details.

D. Samples for Verification: For each type of exposed finish required.

1. Sections of each distinctly different linear railing member, including handrails, top rails, posts, and balusters
2. Fittings, end caps, and brackets.
3. Welded connections.
4. Assembled Sample of railing system, made from full-size components, including top rail, post, handrail, and guard infill, full height and attached to steel plate to simulate top of stringer.

    a. Show method of connecting and finishing members at intersections.

E. Delegated Design Submittal: For railings, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For delegated design professional engineer and testing agency.

B. Welding certificates.

C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.

D. Research Reports: For post-installed anchors, from ICC-ES or other qualified testing agency acceptable to authorities having jurisdiction.

E. Preconstruction test reports.

1.6 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel in accordance with the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for fabrication and installation.

1. Build mockups for each form and finish of railing, consisting of two posts, top rail, infill area, and anchorage system components that are full height and are not less than 24 inches in length.

1.7 PRECONSTRUCTION TESTING

A. Preconstruction Testing Service: Engage a qualified testing agency to perform preconstruction testing on laboratory mockups. Payment for these services will be made by Contractor. Retesting of products that fail to meet specified requirements is to be done at Contractor's expense.

1. Build laboratory mockups at testing agency facility; use personnel, materials, and methods of construction that will be used at Project site.
2. Test railings in accordance with ASTM E894 and ASTM E935.

3. Notify Architect seven days in advance of the dates and times when laboratory mockups will be tested.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Protect mechanical finishes on exposed surfaces of railings from damage by applying a strippable, temporary protective covering before shipping.

1.9 FIELD CONDITIONS

A. Field Measurements: Verify actual locations of walls and other construction contiguous with railings by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design railings, including attachment to building construction.

B. Structural Performance: Railings, including attachment to building construction, are to withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

1. Handrails and Top Rails of Guards:

a. Uniform load of 50 lbf/ft. applied in any direction.
b. Concentrated load of 200 lbf applied in any direction.
c. Uniform and concentrated loads need not be assumed to act concurrently.

2. Infill of Guards:

a. Concentrated load of 50 lbf applied horizontally on an area of 1 sq. ft..
b. Infill load and other loads need not be assumed to act concurrently.

2.2 METALS, GENERAL

A. Metal Surfaces, General: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.

B. Brackets, Flanges, and Anchors: Same metal and finish as supported rails unless otherwise indicated.

2.3 STEEL AND IRON DECORATIVE RAILINGS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Julius Blum.
2. Livers Bronze Co.
3. Tri Tech, Inc.
4. VIVA Railings, LLC.
5. Wagner Companies (The); R&B Wagner, Inc.
6. Wiemann Metalcraft.

B. Source Limitations: Obtain steel decorative railing components from single source from single manufacturer.

C. Recycled Content of Steel Products: Provide products with postconsumer recycled content plus one-half of preconsumer recycled content to the extent required to comply with the minimum criteria specified in Section 01 81 13.14 “Sustainable Design Requirements.”

D. Bars: Hot-rolled, carbon steel complying with ASTM A29/A29M, Grade 1010.

E. Plates, Shapes, and Bars: ASTM A36/A36M.

F. Cast Iron: Either gray iron, ASTM A48/A48M, or malleable iron, ASTM A47/A47M, unless otherwise indicated.

2.4 COPPER-ALLOY DECORATIVE RAILINGS

A. Copper and Copper Alloys, General: Provide alloys indicated and with temper to suit application and forming methods, but with strength and stiffness of not less than Temper H01 (quarter hard) for plate, sheet, strip, and bars, and of not less than Temper H55 (light drawn) for tube and pipe.

B. Brass Seamless Tube: ASTM B135/B135M, Alloy UNS C26000 (cartridge brass, 70 percent copper) to match muntz metal.

C. Bronze Plate, Sheet, Strip, and Bars: ASTM B36/B36M, Alloy UNS C28000 (muntz metal, 60 percent copper).

2.5 FASTENERS

A. Fastener Materials:

1. Copper-Alloy (Brass) Railing Components: Silicon bronze (Alloy 651 or Alloy 655) fasteners where concealed; brass (Alloy 260 or Alloy 360) fasteners where exposed.
2. Ungalvanized-Steel Railing Components: Plated-steel fasteners complying with ASTM F1941/F1941M, Class Fe/Zn 5 for electrodeposited zinc coating where concealed; Type 304 stainless steel fasteners where exposed.
3. Dissimilar Metal Railing Components: Type 304 stainless steel fasteners.
4. Finish exposed fasteners to match appearance, including color and texture, of railings.

B. Fasteners for Anchoring to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings to other types of construction and capable of withstanding design loads.

C. Provide concealed fasteners for interconnecting railing components and for attaching railings to other work unless otherwise indicated.

2.6 MISCELLANEOUS MATERIALS

A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

B. Lacquer for Copper Alloys: Clear acrylic lacquer specially developed for coating copper-alloy products.

2.7 FABRICATION

A. Fabricate railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage, but not less than that required to support structural loads.

B. Shop assemble railings to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations.

1. Clearly mark units for reassembly and coordinated installation.
2. Use connections that maintain structural value of joined pieces.

C. Cut, drill, and punch metals cleanly and accurately.

1. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated.
2. Remove sharp or rough areas on exposed surfaces.

D. Form work true to line and level with accurate angles and surfaces.

E. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items.

F. Connections: Fabricate railings with welded connections unless otherwise indicated.

G. Welded Connections: Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove flux immediately.
4. At exposed connections, finish exposed welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Finish #1 welds; ornamental quality with no evidence of a welded joint.

H. Form changes in direction as follows:

1. As detailed.

I. Bend members in jigs to produce uniform curvature for each configuration required. Maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.

J. Close exposed ends of hollow railing members with prefabricated cap and end fittings of same metal and finish as railings.

K. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, handrail brackets, miscellaneous fittings, and anchors to interconnect railing members to other Work unless otherwise indicated.

1. At brackets and fittings fastened to plaster or gypsum board partitions, provide crush-resistant fillers or other means to transfer loads through wall finishes to structural supports and to prevent bracket or fitting rotation and crushing of substrate.

2.8 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipment.

C. Appearance of Finished Work: Noticeable variations in same piece are unacceptable. Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.9 COPPER-ALLOY FINISHES

A. Finish designations for copper alloys comply with the system for designating copper-alloy finish systems defined in NAAMM's "Metal Finishes Manual for Architectural and Metal Products."

1. Hand-Rubbed Finish, Lacquered: CDA M31-M34-O6x (Mechanical Finish: directionally textured, fine satin; Mechanical Finish: directionally textured, hand rubbed; Coating: clear, organic, air dried, as specified below).

a. Clear, Organic Coating: Lacquer specified for copper alloys, applied by air spray in two coats per manufacturer's written instructions, with interim drying, to a total thickness of 1 mil.

2.10 STEEL AND IRON FINISHES

A. Powder-Coat Finish for Uncoated Ferrous Metal: Prepare, treat, and coat nongalvanized ferrous metal to comply with resin manufacturer's written instructions and as follows:

1. Prepare uncoated ferrous-metal surfaces to comply with SSPC-SP 6/NACE No. 3.
2. Treat prepared metal with iron-phosphate pretreatment, rinse, and seal surfaces.

3. Apply thermosetting polyester or acrylic urethane powder coating with cured-film thickness of not less than 1.5 mils.
4. Color: As preselected and indicated in Finish Schedule.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine gypsum board assemblies, where reinforced to receive anchors, to verify that locations of concealed reinforcements have been clearly marked for Installer. Locate reinforcements and mark locations if not already done.

3.2 INSTALLATION, GENERAL

A. Perform cutting, drilling, and fitting required for installing railings.

1. Fit exposed connections together to form tight, hairline joints.
2. Install railings level, plumb, square, true to line; without distortion, warp, or rack.
3. Set railings accurately in location, alignment, and elevation; measured from established lines and levels.
4. Do not weld, cut, or abrade surfaces of railing components that have been coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
5. Set posts plumb within a tolerance of 1/16 inch in 3 feet.
6. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet.

B. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

1. Coat concealed surfaces of copper alloys that will be in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.

C. Adjust railings before anchoring to ensure matching alignment at abutting joints.

D. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing railings and for properly transferring loads to in-place construction.

3.3 RAILING CONNECTIONS

A. Nonwelded Connections: Use mechanical or adhesive joints for permanently connecting railing components. Use wood blocks and padding to prevent damage to railing members and fittings. Seal recessed holes of exposed locking screws, using plastic cement filler colored to match finish of railings.

B. Welded Connections: Use fully welded joints for permanently connecting railing components. Comply with requirements for welded connections in "Fabrication" Article, whether welding is performed in the shop or in the field.

C. Expansion Joints: Install expansion joints not farther apart than required to accommodate thermal movement. Provide slip-joint internal sleeve, extending 2 inches beyond joint on either side; fasten internal sleeve securely to one side; and locate joint within 6 inches of post.

3.4 ANCHORING POSTS

A. Mechanically anchor posts to metal surfaces as indicated with fasteners of type and spaced as required to comply with Performance Requirements:

3.5 ATTACHING RAILINGS

A. Attach handrails to walls with wall brackets. Provide brackets with 1-1/2-inch clearance from inside face of handrail and finished wall surface.

1. Use type of bracket with flange tapped for concealed anchorage to threaded hanger bolt.
2. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.

B. Secure wall brackets and railing end flanges to building construction by one of the following methods:

1. For steel-framed partitions, use hanger or lag bolts set into fire-retardant-treated wood backing between studs. Coordinate with stud installation to locate backing members.
2. For steel-framed partitions, fasten brackets directly to steel framing or concealed steel reinforcements using self-tapping screws of size and type required to support structural loads.

3.6 REPAIR

A. Touchup Painting:

1. Immediately after erection, clean bolted connections, and abraded areas of powder coated shop finish, and paint exposed areas with the same material used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

3.7 FIELD QUALITY CONTROL

A. Testing Agency: Owner may engage a qualified testing agency to perform tests and inspections and to prepare test reports. Payment for these services will be made by Owner.

B. Extent and Testing Methodology: Testing agency will randomly select completed railing assemblies for testing that are representative of different railing designs and conditions in the completed Work. Test railings in accordance with ASTM E894 and ASTM E935 for compliance with performance requirements.

C. Remove and replace railings where test results indicate that they do not comply with specified requirements unless they can be repaired in a manner satisfactory to Architect and comply with specified requirements.

D. Perform additional testing and inspecting, at Contractor's expense, to determine compliance of replaced or additional work with specified requirements.

3.8 CLEANING

A. Clean by washing thoroughly with clean water and soap, rinsing with clean water, and wiping dry.

B. Clean copper alloys in accordance with metal finisher's written instructions in a manner that leaves an undamaged and uniform finish matching approved Sample.

3.9 PROTECTION

A. Protect finishes of railings from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at time of Substantial Completion.

B. Restore finishes damaged during installation and construction period, so no evidence remains of correction work. Return items that cannot be refinished in the field to the shop; make required alterations and refinish entire unit, or provide new units.

END OF SECTION

This page is intentionally left blank.

SECTION 05 73 13 - GLAZED DECORATIVE METAL RAILINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Glazed decorative metal barrier railings including entrance gate complete.

1.2 DEFINITIONS

A. Railings: Guards, handrails, and similar devices for pedestrian guidance and support and visual separation.

1.3 COORDINATION AND SCHEDULING

A. Coordinate installation of anchorages for railings. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete. Deliver items to Project site in time for installation.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.5 ACTION SUBMITTALS

A. Product Data:

1. Glass products.
2. Structural glass railings.
3. Accessories, including hardware, for structural glass railings and gates.
4. Fasteners.

B. Shop Drawings: Include plans, elevations, sections, and attachment details.

C. Samples for Verification: For each type of exposed finish required.

1. Base channel.
2. Each type of glass and glass edge required.
3. Handrail fittings and brackets.
4. Assembled Samples of railing systems, made from full-size components, including handrail and structural glass balusters. Samples need not be full height.

D. Delegated Design Submittal: For installed products indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For professional engineer.

B. Product Test Reports: For tests performed by a qualified testing agency, in accordance with ASTM E894, ASTM E935, ASTM E2353, and ASTM E2358.

C. Evaluation Reports: From ICC-ES or other qualified testing agency acceptable to authorities having jurisdiction.

1. For glazed decorative metal railings.
2. For post-installed anchors.

1.7 WARRANTY

A. Manufacturer's Special Warranty for Laminated Glass: Glazed decorative metal railing manufacturer agrees to replace laminated-glass units that deteriorate within specified warranty period. Deterioration of laminated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning laminated glass contrary to manufacturer's written instructions. Defects include edge separation, delamination materially obstructing vision through glass, and blemishes exceeding those allowed by referenced laminated-glass standard.

1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design glazed decorative metal railings, including attachment to building construction.

B. General: In engineering railings to withstand structural loads indicated, determine allowable design working stresses of railing materials based on the following:

1. Aluminum: The lesser of minimum yield strength divided by 1.65, or minimum ultimate tensile strength divided by 1.95.
2. Glass: 25 percent of mean modulus of rupture (50 percent probability of breakage), as listed in "Mechanical Properties" in AAMA CW-12, "Structural Properties of Glass."

C. Structural Performance: Railings, including attachment to building construction, are to withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

1. Handrails and Top of Guards:

    a. Uniform load of 50 lbf/ft. applied in any direction.
    b. Concentrated load of 200 lbf applied in any direction.
    c. Uniform and concentrated loads need not be assumed to act concurrently.

2. Structural Glass Railings and Glass-Infill Panels:

    a. Concentrated load of 50 lbf applied horizontally on an area of 1 sq. ft..
    b. Infill load and other loads need not be assumed to act concurrently.

3. For structural glass railings, support each section of handrail by a minimum of three glass panels or by other means so railings will remain in place if any one glass panel fails.

2.2 GLAZED DECORATIVE METAL RAILINGS

A. Source Limitations for Laminated Glass: Obtain from single source from single manufacturer.

B. Source Limitations for Decorative Metal Railing Components: Obtain from single source from single manufacturer for each component and installation method.

C. Basis-of-Design Product: Subject to compliance with requirements, provide **C.R. Laurence Co., Inc.; CRH Americas, Inc.; TAPER-LOC Dry Glazing System for Laminated Tempered Glass** or a comparable product by one of the following:

1. Livers Bronze Co.
2. Southwest Metalsmiths, Inc.
3. VIVA Railings, LLC.
4. Wagner Companies (The); R&B Wagner, Inc.

D. Components:

1. Shoe Base: CRL Part #L56S, 9BL56 Series Square Profile; surface mounted.
2. Metal Cap Railing: CRL Part #GRCF5, 16 ga. crisp corner cap rail.
3. Handrail Bracket: CRL Part HR20GAPB, La Jolla Series.
4. Handrail CRL Part HR20PB.

E. Gates: Provide all glass swinging gate supported by adjacent structural glass railing and pivot post with all necessary hardware including, but not limited to, recessed floor closer, bronze pivot hinges and stop with finish to match base shoe cladding.

F. Product Options: Information on Drawings and in the Specifications establishes requirements for railing system's aesthetic effects and performance characteristics. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction.

1. Do not change intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If changes are proposed, submit comprehensive explanatory data to Architect for review.

2.3 METALS, GENERAL

A. Metal Surfaces, General: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.

B. Brackets, Flanges, and Anchors: Same metal and finish as supported rails unless otherwise indicated.

2.4 ALUMINUM

A. Aluminum, General: Provide alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with strength and durability properties for each aluminum form required not less than that of alloy and temper designated below.

B. Extruded Bars and Shapes, Including Extruded Tube: ASTM B221, Alloy 6063-T5/T52.

2.5 COPPER ALLOYS

A. Bronze Plate, Sheet, Strip, and Bars: ASTM B36/B36M, Alloy UNS C28000 (muntz metal, 60 percent copper).

2.6 GLASS AND GLAZING PRODUCTS, GENERAL

A. Glazing Publications: Comply with written instructions of glass product manufacturers and organizations below unless more stringent requirements are indicated. See these publications for glazing terms not otherwise defined in this Section or in referenced standards.

1. NGA/GANA Publications: "GANA Laminated Glazing Reference Manual" and "GANA Glazing Manual."

B. Safety Glazing: Glazing is to comply with 16 CFR 1201, Category II.

C. Safety Glazing Labeling: Provide as needed to comply with requirements of authority-having-jurisdiction in the following order of preference:

1. Provide safety glazing with no permanent mark on glass. Provide certification letter from manufacturer to authority-having-jurisdiction indicating that glass complies with requirements for safety glazing including manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.
2. Permanently mark glass with certification label of the SGCC or another certification agency acceptable to authorities having jurisdiction concealed from view by glazed decorative metal railing base shoe once glazing is installed. Label is to indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.
3. Permanently mark glass with certification label of the SGCC or another certification agency acceptable to authorities having jurisdiction located consistently in lower right hand corner of glass just above the base shoe. Label is to indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.

D. Low-Iron Float Glass: ASTM C1036, Type I, Class I (clear), Quality-Q3; and with visible light transmission of not less than 91 percent.

E. Accessories for Structural Glass Railings: Dry glaze system including setting blocks, shims, gaskets, and related accessories as recommended or supplied by railing manufacturer for installing structural glazing in metal base channels.

2.7 GLASS HANDRAILS AND GUARDS

A. Laminated Glass Handrails and Guards, IGL-3: ASTM C1172, Type II with two plies of glass bonded together by an interlayer.

1. Construction: Laminate glass with ionoplast polymer interlayer to comply with interlayer manufacturer's written instructions.
2. Interlayer Thickness: 0.060 inch.
3. Kind: LT (laminated tempered).
4. Glass Color: Inner-ply low-iron clear; outer-ply low-iron clear.
5. Interlayer Color: Clear.
6. Glass Plies for Structural Glass Balusters: Thickness required by structural loads, but not less than 6.0 mm thick each.

2.8 FASTENERS

A. Fasteners for Anchoring to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings to other types of construction indicated and capable of withstanding design loads.

1. Expansion Anchors:

a. Basis-of-Design Product: Subject to compliance with requirement, provide **HILTI; HSL3; CRL Part # EBA334** or comparable product.

2.9 MISCELLANEOUS MATERIALS

A. Handrail Brackets: Cast brass, center of rail 3-1/8 inches from face of structural glass balusters.

B. Lacquer for Copper Alloys: Clear acrylic lacquer specially developed for coating copper-alloy products.

2.10 FABRICATION OF GLASS PANELS AND BALUSTERS

A. Fabricate glass to sizes and shapes required; provide for proper edge clearance and bite on glazing panels.

B. Structural Glass Balusters: Provide laminated, tempered structural glass balusters.

1. Edge Finish: Grind smooth and flat polish exposed edges of glass, including those at open joints, to produce smooth, square edges with glass edge finishes.

2. Fabricate structural glass balusters to maintain equal length glass widths and uniform spacing of 1/2 inch between glass balusters.

2.11 METAL FINISH REQUIREMENTS, GENERAL

A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipment.

B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.12 ALUMINUM FINISHES

A. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.

2.13 COPPER-ALLOY FINISHES

A. Finish designations for copper alloys comply with the system for designating copper-alloy finish systems defined in NAAMM/NOMMA 500, "Metal Finishes Manual for Architectural and Metal Products."

B. Lacquered Hand-Rubbed Finish: M31-M34-O6x (Mechanical Finish: directionally textured, fine satin; Mechanical Finish: directionally textured, hand rubbed; Coating: clear, organic, air dried, as specified below).

1. Clear, Organic Coating: Lacquer specified for copper alloys, applied by air spray in two coats per manufacturer's written instructions, with interim drying, to a total thickness of 1 mil.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Comply with Drawings and manufacturer's written instructions for installing glazed decorative metal railings, accessories, and other components.

B. Perform cutting, drilling, and fitting required for installing metal railings.

1. Fit exposed connections together to form tight, hairline joints.
2. Install railings level, plumb, square, true to line; without distortion, warp, or rack.
3. Set railings accurately in location, alignment, and elevation; measured from established lines and levels.
4. Do not weld, cut, or abrade surfaces of metal railing components that have been coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.

C. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

1. Coat concealed surfaces of aluminum that will be in contact with grout, concrete, masonry, wood, or dissimilar metals, with shop primer.

D. Adjust railings before anchoring to ensure matching alignment at abutting joints.

E. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing railings and for properly transferring loads to in-place construction.

3.2 INSTALLATION OF GLASS BALUSTERS

A. Structural Glass Railings:

1. Install assembly to comply with railing manufacturer's written instructions.
2. Adjust spacing of glass balusters so gaps between balusters are equal before securing in position.

3.3 CLEANING

A. Clean aluminum by washing thoroughly with water and soap, rinsing with clean water, and wiping dry.

B. Clean and polish glass as recommended in writing by manufacturer. Wash both exposed surfaces in each area of Project not more than four days before date scheduled for inspections that establish date of Substantial Completion.

3.4 PROTECTION

A. Protect finishes of railings from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at time of Substantial Completion.

B. Restore finishes damaged during installation and construction period so no evidence remains of correction work. Return items that cannot be refinished in the field to the shop; make required alterations and refinish entire unit, or provide new units.

END OF SECTION

This page is intentionally left blank.

SECTION 05 75 00 - DECORATIVE FORMED METAL

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Decorative-metal-clad door frames.
2. Decorative-metal-clad wall panels.

B. Related Requirements:

1. Section 08 11 13 “Hollow Metal Doors and Frames” for custom steel doors with bronze faces.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product, including finishing materials.

B. Sustainable Design Submittals:

1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.
2. Product Data: For adhesives, indicating VOC content.
3. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting materials.

C. Shop Drawings: Show fabrication and installation details for decorative formed metal.

1. Include plans, elevations, component details, and attachment details.
2. Indicate materials and profiles of each decorative formed metal member, fittings, joinery, finishes, fasteners, anchorages, and accessory items.

D. Samples for Verification: For each type of exposed finish required, prepared on 6-inch-square Samples of metal of same thickness and material indicated for the Work.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For copper-alloy finish to include in maintenance manuals.

1.5 QUALITY ASSURANCE

A. Fabricator Qualifications: A firm experienced in producing decorative formed metal similar to that indicated for this Project and with a record of successful in-service performance as well as sufficient production capacity to produce required units.

B. Installer Qualifications: Fabricator of products.

C. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for fabrication and installation.

1. Build mockups for the following types of decorative formed metal:

a. Wall cladding including adjacent clad door.

2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver decorative formed metal products wrapped in protective coverings and strapped together in suitable packs or in heavy-duty cartons. Remove protective coverings before they stain or bond to finished surfaces.

B. Store products on elevated platforms in a dry location.

1.7 FIELD CONDITIONS

A. Field Measurements: Verify actual locations of walls, columns, beams, and other construction contiguous with decorative formed metal by field measurements before fabrication and indicate measurements on Shop Drawings.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. For decorative metal items, obtain each color, grade, finish, type, and variety of metal from single source with resources to provide products of consistent quality in appearance and physical properties.

2.2 SHEET METAL

A. General: Fabricate products from sheet metal without pitting, seam marks, roller marks, stains, discolorations, or other imperfections where exposed to view on finished units.

B. Recycled Content of Steel Products: Provide products with postconsumer recycled content plus one-half of preconsumer recycled content to the extent required to comply with the minimum criteria specified in Section 01 81 13.14 “Sustainable Design Requirements.”

C. Bronze Sheet: ASTM B36/B36M, Alloy UNS C28000 (muntz metal, 60 percent copper).

2.3 MISCELLANEOUS MATERIALS

A. Laminating Adhesive: Adhesive recommended by metal fabricator that will fully bond metal to metal, will prevent telegraphing and oil-canning, and is compatible with substrate and noncombustible after curing.

1. Verify adhesives have a VOC content of 70 g/L or less.
2. Verify adhesive complies with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

2.4 FABRICATION, GENERAL

A. Shop Assembly: Preassemble decorative formed metal items in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.

B. Coordinate dimensions and attachment methods of decorative formed metal items with those of adjoining construction to produce integrated assemblies with closely fitting joints and with edges and surfaces aligned unless otherwise indicated.

C. Form metal to profiles indicated, in maximum lengths to minimize joints. Produce flat, flush surfaces without cracking or grain separation at bends. Fold back exposed edges of unsupported sheet metal to form a 1/2-inch-wide hem on the concealed side, or ease edges to a radius of approximately 1/32 inch and support with concealed stiffeners.

D. Increase metal thickness or reinforce with concealed stiffeners, backing materials, or both, as needed to provide surface flatness equivalent to stretcher-leveled standard of flatness and sufficient strength for indicated use.

1. Support joints with concealed stiffeners as needed to hold exposed faces of adjoining sheets in flush alignment.

2.5 DECORATIVE-METAL-CLAD DOOR FRAMES

A. Laminate metal sheets, of type and thickness indicated below, to faces hollow-metal frames and elevator entrances where indicated. Use adhesive that will fully bond metal to metal and that will prevent telegraphing and oil-canning.

1. Bronze Sheet: 0.040 inch.

a. Finish: Hand-rubbed satin finish, lacquered.

2.6 DECORATIVE-METAL-CLAD WALL PANELS

A. Laminate metal sheets, of type and thickness indicated below, to faces of MDF wall panels in configurations shown where indicated. Use adhesive that will fully bond metal to metal and that will prevent telegraphing and oil-canning. Attach panels to substrate with zee-clips comparable to Monarch Metal Inc. MF250

1. Bronze Sheet: 0.040 inch.

a. Finish: Hand-rubbed satin finish, lacquered.

2.7 GENERAL FINISH REQUIREMENTS

A. Complete mechanical finishes of flat sheet metal surfaces before fabrication where possible. After fabrication, finish all joints, bends, abrasions, and other surface blemishes to match sheet finish.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.8 COPPER-ALLOY FINISHES

A. Lacquered Hand-Rubbed Finish: M31-M34-O6x (Mechanical Finish: directionally textured, fine satin; Mechanical Finish: directionally textured, hand rubbed; Coating: clear, organic, air dried, as specified below).

1. Clear, Organic Coating: Lacquer specified for copper alloys, applied by air spray in two coats per manufacturer's written instructions, with interim drying, to a total thickness of 1 mil.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of decorative formed metal.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Locate and place decorative formed metal items level and plumb and in alignment with adjacent construction. Perform cutting, drilling, and fitting required to install decorative formed metal.

1. Do not cut or abrade finishes that cannot be completely restored in the field. Return items with such finishes to the shop for required alterations, followed by complete refinishing, or provide new units as required.

B. Use concealed anchorages.

C. Where adhesive mounting is indicated, fully coat decorative formed metal and secure to substrate.

D. Form tight joints accurately fitted together.

E. Corrosion Protection: Apply bituminous paint or other permanent separation materials on concealed surfaces where metals would otherwise be in direct contact with substrate materials that are incompatible or could result in corrosion or deterioration of either material or finish.

F. Install decorative-formed-metal-clad doors and frames to comply with requirements specified in Section 08 11 13 "Hollow Metal Doors and Frames."

3.3 ADJUSTING AND CLEANING

A. Unless otherwise indicated, clean metals by washing thoroughly with water and soap, rinsing with clean water, and drying with soft cloths.

B. Clean copper alloys according to metal finisher's written instructions in a manner that leaves an undamaged and uniform finish matching approved Sample.

C. Restore finishes damaged during installation and construction period so no evidence remains of correction work. Return items that cannot be refinished in the field to the shop; make required alterations and refinish entire unit or provide new units.

D. Remove excess adhesive using methods and materials recommended in writing by manufacturer.

3.4 PROTECTION

A. Protect finishes of decorative formed metal items from damage during construction period. Remove temporary protective coverings at time of Substantial Completion.

END OF SECTION

This page is intentionally left blank.

SECTION 06 01 40.99 - RELOCATION, REUSE, AND RESTORATION OF HISTORIC COURTROOM WOODWORK

PART 1 - GENERAL

1.1 SUMMARY

A. Description of Work:

1. Remove, protect, transport, restore, and reinstall with minor modifications for code compliance and functionality, Historic Courtroom architectural woodwork from the existing Supreme Court of Maryland building to the new Supreme Court of Maryland building as indicated on Drawings.
2. Furnish all labor, materials, tools, equipment, and services necessary for and reasonably incidental to complete the removal, repair, refinishing, and installation of existing historic architectural woodwork, including but not limited to the following:

    a. Assessment of the existing historic architectural woodwork in its existing location and documentation of it as indicated, including reporting of any previously unknown information relevant to this work, and including letter and/or number designations of each piece to be removed, rehabilitated, and reinstalled.
    b. Removal of miscellaneous, non-original hardware, fasteners, conduit, etc. from the existing woodwork, and salvaging and restoration of historic accoutrements attached to the historic woodwork, including clocks and gas lighting valve covers, as well as door hardware and their preparation for reinstallation.
    c. Planning fabrication, finishing, and installation of closely matching and closely integrated new architectural woodwork with historic woodwork.
    d. Cleaning and repair of all indicated existing historic architectural woodwork including rail and stile wall paneling with wood carved ornamentation, entry door pediments, wood base, chair rail, cornice molding with dentil course, doors, doorframes and associated trim, and cased openings.
    e. Repair and preparation for transparent stain finish.
    f. Similar treatment of the historic judge's bench, courtroom furniture including attorney tables and clerk's table, and the gallery and spectator rails including carved and turned newels and balusters with carved ornamentation.
    g. As with new woodwork items to match historic ones, produce new speaker podium as indicated on Drawings to closely match and be integrated with existing courtroom furniture and related items, all being integrated with and closely relating to historic architectural woodwork.
    h. Coordination of historic woodwork installation with work of other trades including, but not limited to, items for life safety, telecommunications, and other trades including, but not limited to, courtroom cameras, components of security systems, audio/visual systems, lighting, receptacles, and other components of new facility's utility systems.

3. The new Supreme Court of Maryland courtroom is larger than the current one. Work includes custom fabrication of two bays of new wood wall paneling to match the historic wall paneling in detail and finish. Install new paneling with associated trim to adjoin and integrate with reinstalled historic woodwork, and to match the historic woodwork very closely in appearance.

4. Clean, repair, and refinish all reinstalled historic paneling and trim including preparation for transparent stains.
5. Clean, repair, refinish, and reattach historic integrated components including metal fixtures and clocks, and incorporate minor modifications for code and regulatory compliance and for functionality as shown in Drawings such that character-defining features and aspects of historic architectural woodwork with historic appurtenances are minimally impacted while contemporary functionality is achieved, for example, integrating items such as new motorized projection screens, information technology devices, communications devices, and life safety components within or on wood paneling.

B. Related Requirements:

1. Section 02 41 19 "Selective Demolition" for selective demolition in existing courthouse related to removal of existing historic courtroom woodwork.
2. Section 06 10 00 "Rough Carpentry" for wood furring, blocking, shims, and hanging strips required for installing interior architectural woodwork that are concealed within other construction before interior architectural woodwork installation.
3. Section 06 42 14 "Stile and Rail Wood Paneling" for new transparent finished interior paneling to match historic wood paneling to be integrated with reinstalled historic architectural woodwork in Historic Courtroom; for materials, products, installation requirements and other aspects similar to those required of new woodwork to match historic and of historic woodwork in Historic Courtroom. All architectural woodwork in facility is to be compatible, consistent, and related in appearance, installation, and work performance.
4. Section 06 44 00 "Ornamental Woodwork" for new interior millwork exposed to view, similar relationship to woodwork in Historic Courtroom as woodwork in section 06 42 14 "Stile and Rail Wood Paneling" and 06 40 23 “Interior Architectural Woodwork.”
5. Section 08 14 16 "Flush Wood Doors" and Section 08 14 33 "Stile and Rail Wood Doors" for fire-rated wood door frames that require testing with fire-rated doors for materials, products, installation requirements and other aspects similar to those required of new woodwork to match historic and of historic woodwork in Historic Courtroom; for testing required of fire-rated doors, and similar relationship to woodwork in Historic Courtroom as woodwork in section 06 42 14 "Stile and Rail Wood Paneling."

1.2 COORDINATION

A. Coordinate investigation and assessment of historic architectural woodwork in its existing location and its removal from there with Owner, including work hours, access, equipment, utilities, parking, and cutting and patching.

B. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections, to ensure that historic architectural woodwork and new architectural woodwork to match and be integrated into historic architectural woodwork assemblies can be supported and installed as indicated.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site or at location where repairs will be completed as approved by Architect.

1. Review schedule, logistics, and methods and procedures related to historic architectural woodwork dismantling, storage, repair, and reinstallation including, but not limited to, the following:

    a. Verify woodwork repair specialist's personnel meet required qualifications requirements, indicate those to perform Project work in shop and those in field, and provide contact information for those responsible for overseeing shop work, field work, and for managing Project and coordinating with General Contractor, Owner, and Architect.
    b. Verify equipment and facilities needed to make progress and avoid delays.
    c. Verify when this work is to occur within overall Project schedule, including dismantling, transport, shop work, storage, and installation, such that work necessary prior to installation will occur adequately in advance so that this work will not interfere with other work scheduled to be performed simultaneously or after, and that this work can be performed satisfactorily while maintaining the overall schedule.
    d. Review dismantling, transportation, shop work, storage, and installation operations, and review existing and proposed materials, material applications, requirements for submittals, progress documentation and mockups, and requirements for sequencing, tolerances, and required clearances, as well as support required from General Contractor and others at any points throughout work performance.
    e. Review requirements for facilities, utilities, environmental conditions, and any other necessities to be provided by others at any points throughout work performance.
    f. Review quality-control program, indicate trade point of contact for it, and ensure its coordination with General Contractor’s quality-control program.
    g. Review close-out procedures, Project record documents, demonstration and training, necessary maintenance required or planned for associated with this work.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product, including woods, anchors, other joinery and clips, adhesives, shop and field finishing materials:

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
2. Include recommendations for product application and use.
3. Include test data substantiating that products comply with requirements.

B. Sustainable Design Submittals

1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.
2. Chain-of-Custody Certificates: For certified wood products. Include statement of costs.
3. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting materials.
4. Laboratory Test Reports: For composite wood products, indicating compliance with requirements for low-emitting materials.
5. Any other items as required by project’s pursuing LEED certification in compliance with Maryland High Performance Green Building Program.

C. Shop Drawings:

1. Include dimensioned plans, elevations, sections, and locations of repaired and replaced historic architectural woodwork and new architectural woodwork adjoining historic and to match historic woodwork, and their repairs, jointing, and attachments, showing relations with adjoining work.
2. Indicate reproduction of missing or damaged portions of architectural woodwork. Include plans, elevations, and full-size detail sections showing materials, methods, finishes, joinery, fasteners, anchorages, and accessory items as appropriate.
3. Show partial replacement wood units (dutchmen).
4. Show provisions for sealant or other joints.
5. Show provisions for projection screens and their motors mounted within historic architectural woodwork paneling, attachments of historic clocks and gas lamp covers, and for new lighting fixtures, conduits, cameras, telecom components and jacks, security and life safety components within or attached to woodwork of this Section; mechanical, electrical, plumbing, and other components to be within or attached to assemblies of this Section, or any other required utility or associated facility items as required which must be integrated with woodwork of this Section.
6. Show replacement and repair anchorage. Include details of anchors within individual wood units, with locations of anchors and dimensions of any holes and recesses in wood required for anchors, including direction and angle of holes for pins.
7. Show locations of scaffolding or other access provisions and points of scaffolding or other in contact with historic wood. Include details of each point of contact or anchorage.

D. Samples for Verification: For the following:

1. Replacement wood in historic material and new wood items to match historic woodwork. To show full range of color, texture, grain, veining, and finish to be expected. Provide at least two 12 by 12 inch replacement wood Samples, but no fewer than necessary to indicate full range and proportion of variations within range, indicating grade and species. Submit 6-inch long Samples of each new molding. Accepted Samples will establish the color, finish, and quality for work of this Section.
2. Veneer Leaves: Representative of and selected from flitches to be used for transparent-finished interior architectural woodwork, for woodwork to have new veneer, which is to match veneer of existing historic woodwork.
3. Each type of patching compound in form of briquettes, at least 3 inches long by 1-1/2 inches wide. Document each Sample with manufacturer and stock number or other information necessary to order additional material.
4. Accessories: Each type of anchor, accessory, and miscellaneous support or other accessory indicated or determined to be necessary.

E. Historic Accoutrements

1. Historic Clocks: Historic clocks are attached to the historic architectural woodwork. Investigate historic clocks in place and assess them with the assistance of a qualified horologist specialized and sufficiently experienced in historic clock restoration and repair. Provide a description of scope of repair and restoration work for historic clocks including quantities, removal from existing locations, disassembly as required, repairs as required, restoration of existing materials with as much existing to be retained as possible, replacement of components as necessary, proposed materials and products for use in this work and concise description of work methodologies, locations and necessary environmental requirements, necessary support or provisions of General Contractor and others so horologist can complete required work, and description of reinstallation. Horologist to perform this work must meet qualifications requirements similar to those of historic architectural woodwork specialist including years of experience performing similar

work. And performance requirements will also be similar, including submittals, shop drawings, quality assurance, Historic Clocks Repair, Relocation, and Reinstallation Plan. Include of a restored clock in historic architectural woodwork mockup, and work performance meeting requirements of this Section as applicable.

2. Historic Gas Lighting Valve Covers: Historic gas lighting valve covers are metal and attached to the historic architectural woodwork. They are to be salvaged from their existing locations, restored as appropriate for historic metal with restored appearance to match original appearance as best as can be determined, and reinstalled in historic architectural woodwork. This work is to be performed by a specialist with experience performing similar historic metal restoration work, similar to qualifications requirements of horologist for historic clocks work, and other performance and products requirements are similar to those for horologist. Historic architectural woodwork mockup is to include a restored historic gas lighting valve cover.

3. Any Other Historic Accoutrements: There are no other known historic accoutrements associated with the historic architectural woodwork which are to be salvaged, restored as necessary and reinstalled with the woodwork in its new location. But Contractor is to investigate the historic architectural woodwork in its current location, inform Architect of any other historic accoutrements which may be found, and comply with Architect's direction regarding whether such are to be salvaged, restored, and reinstalled.

1.5 INFORMATION SUBMITTALS

A. Qualification Data: For woodwork repair specialist firm and for individual workers who will perform the work including field supervisors and craftsmen, horologist, and metal restoration specialist.

B. Architectural Woodwork Disassembly, Storage, Repair, Relocation, and Reinstallation Plan.

C. Quality-control program.

D. Product Certificates: For the following:

1. Composite wood products.
2. Cleaning and preparation products.
3. Adhesives and wood fillers.
4. Wood stain, clear finish, and finish wax.
5. Accessory materials, including cleaning accessories and solvents.
6. Miscellaneous anchors and any other products used in this work.

1.6 QUALITY ASSURANCE

A. Historic Architectural Woodwork Repair Specialist Qualifications: Engage an experienced woodwork repair firm with a minimum of five years' experience in the repair, restoration, and refinishing of historic woodwork of the kind similar to the scope of that to be performed in this Section. Firm shall have completed work similar in material, design, and extent to that indicated for this Project with a record of successful in-service performance. Experience in only performing standard wood repairs or installing new woodwork is insufficient experience for historic architectural woodwork repair, matching, and reinstallation work.

1. Submit a written record of a minimum of three projects completed in the last five years for which the architectural woodwork repair specialist firm has performed wood restoration, the same as required for this project. Projects submitted shall be similar in scope and size to this project. Include the name and address of the building, a description of the work performed, the approximate cost of the work, and the name and telephone number of a reference for the project.
2. Field Supervision: Architectural woodwork repair specialist firm shall maintain experienced full-time supervisors on Project site during times that woodwork assessment, repair, and reinstallation work is in progress.
3. Submit the qualifications of all individuals who will be working at the project sites and shops with evidence of their experience in wood restoration, including experience similar to the work of this Project. Include the names of the projects for which similar work has been performed and years of experience with the firm and years of relevant experience with other firms. Only persons with acceptable previous experience and only those persons whose qualifications have been reviewed and accepted will be allowed to perform the work.
4. Architectural Woodwork Repair Worker Qualifications: When architectural woodwork units and components are being patched, assign at least one worker per crew who is trained and certified by manufacturer of patching compound to apply its products.
5. Comply with applicable requirements of "Architectural Woodwork Quality Standards" published by the Architectural Woodwork Institute.

B. Architectural Woodwork Disassembly, Storage, Repair, Relocation, and Reinstallation Plan: Prepare a written report detailing means and methods for assessing historic architectural woodwork in its existing location, for documenting, disassembling, moving, storing, repairing, refinishing, relocating, protecting, lifting into place, and reinstalling historic architectural woodwork, and for coordinating with other work as required and with adjacent work in the new facility; and for producing, installing, finishing, and integrating new architectural woodwork which is to be combined with and to very closely match appearance of historic architectural woodwork, and for coordinating with other work as required; also for assessment at existing location, documentation of, disassembly and removal, storage, repair, and reinstallation integrated with historic architectural woodwork, of historic appurtenances attached to historic woodwork including metal gas light covers and historic clocks. This Plan is to include, but not be limited to, the following:

1. Disassembly Methodology: A written description of disassembly methods, materials, and equipment proposed for use. Include descriptions of transportation of workers, materials, and equipment to and from site from which historic architectural woodwork is to be removed, and use of scaffolding and/or other items planned for use in accessing historic woodwork and performing necessary associated operations. Describe protections of both historic woodwork and historic appurtenances being dissembled during the disassembly work and describe protections to be provided for adjacent areas, and describe daily and final cleaning and demobilization.
2. Shop Operations and Storage: A written description of shop operations and storage facilities, including types and numbers of staff to be engaged in which operations and equipment and describe materials to be used in each operation at each time, and describe environmental conditions to be maintained in shop and in storage, also describing utility systems to be used to maintain these conditions.
3. Cleaning Methodology: A written description of cleaning methods, materials, working pressures and equipment proposed for use. Include description of methods for wastewater collection and disposal.
4. Repair Methodology: A written program for each portion of the historic architectural woodwork repair work, including prior cleaning and preparation, fine crack repair, larger

crack repair, repair of larger gouges and voids, dutchmen repairs, replacement of deleterious wood materials, replacement and/or repair of decorative moldings and profiles, dentils and similar as required, and repair and to extent required replacement of historic accoutrements attached to historic woodwork, Describe in detail the materials, methods, and equipment to be used for each portion of the work.

5. Installation Methodology: A written description of installation methods including transport of workers and materials, storage of products, environmental conditions which must be maintained, coordination as required with General Contractor, other subcontractors, and any others such as utility companies, and related requirements necessary to maintain acceptable environmental conditions and provide adequate power for tools and equipment, lighting, access to potable water, scaffolding provision as necessary, its erection and movement, protections of stored materials for this work and of adjacent or potentially impacted work, required associated safety provisions, locations, quantities and protections of stored materials needed in the work performance, sequence of operations and being performed in which locations with durations for each and numbers and types of staff for each, and specifics for installation location hoisting, cleaning, patching, finishing, final cleaning, and demobilization.

C. Quality-Control Program: Prepare a written quality-control program for this Project to systematically demonstrate the ability of personnel to properly follow methods and use materials and tools without damaging historic architectural woodwork, new woodwork to match, or historic accoutrements attached to historic architectural woodwork. Include provisions for supervising performance and preventing damage.

D. Mockups: Prepare mockups of historic architectural woodwork meeting new architectural woodwork to match historic and with refurbished historic accoutrements attached to historic woodwork. Repair to demonstrate aesthetic effects and to set quality standards for materials and execution and for fabrication and installation.

1. Demonstrate quality of materials, workmanship, and blending of new with existing historic work. Include the following as a minimum:

    a. Cleaning: Four square feet or as required to demonstrate effective cleaning materials and techniques.
    b. Crack injection: Apply crack injection in two separate areas as directed.
    c. Patching: Three small holes (at least 1 inch in diameter) as directed.
    d. Partial Wood Replacement: Two partial wood replacements (dutchman repairs).
    e. Integration of New with Historic: As directed, full height wall panel or as required to demonstrate effective materials and techniques, new architectural woodwork adjoining and integrated with historic woodwork.
    f. Historic Accoutrements: At least one historic clock and one historic gas light cover are to be attached to mockup woodwork.
    g. Other: As required to demonstrate repair techniques and materials to be employed in historic architectural woodwork restoration and reinstallation.

2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
3. Subject to compliance with requirements, approved mockups may become part of the completed work if undisturbed at time of Substantial Completion.

1.7 SCHEDULING

A. Do not install final finish until plaster, painting, wet work, or other operations which could damage, soil or deteriorate the woodwork have been completed in the work areas. Protect work from damage by other trades.

B. Coordinate Architectural Woodwork Disassembly, Storage, Repair, Relocation, and Reinstallation Plan with General Contractor's overall Project schedule to ensure that work which must be completed prior to operations for performing this work is complete prior; that this work coordinates satisfactorily with other work to be performed simultaneously with this work and after, and that this work can be performed satisfactorily within General Contractor's overall Project schedule.

1.8 DELIVERY, HANDLING AND STORAGE

A. Comply with the Architectural Woodwork Institute Standards, Section 2.

B. All materials shall be of grade, brand, and manufacturer as approved by Architect and shall be delivered and stored in the original sealed containers, bearing the Manufacturer's label indicating grade, type, and color.

C. Deliver materials and handle so as to prevent the inclusion of foreign materials and the damage of materials by water, and in ample time to facilitate inspection, tests as applicable, and other operations such as mockups and Architect approvals so as to ensure quality and schedule maintenance. Do not deliver historic architectural woodwork or new architectural woodwork to match until painting and similar finish operations that might damage woodwork have been completed in installation areas.

D. Store woodwork in installation areas or in areas where environmental conditions comply with requirements specified in "Field Conditions" Article of Section 06 40 23 "Interior Architectural Woodwork."

E. All storage spaces shall maintain the minimum storage temperatures and relative humidities recommended by manufacturers of products used in this work and per requirements of these Construction Documents and referenced standards and regulations, including those of the Architectural Woodwork Institute, and shall be protected from direct ground contact and inclement weather, if applicable, and from other contact with water in all storage spaces.

F. No kiln-dried materials shall be placed in any building unit unless the unit is sufficiently dry. Delivery and storage of materials is the responsibility of the General Contractor and the Repair Specialist Firm.

G. Established Dimensions: Where historic architectural woodwork and new woodwork to match is indicated to fit to other construction, establish dimensions for areas where woodwork is to fit. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

1.9 FIELD CONDITIONS AND ENVIRONMENTAL REQUIREMENTS

A. Environmental Limitations without Humidity Control: Do not deliver or install interior architectural woodwork until building is enclosed, wet-work is complete, and HVAC system is operating and maintaining temperature and relative humidity at levels designed for building occupants for the remainder of the construction period.

B. Do not repair wood or apply finishes unless a minimum uniform temperature of not less than 55 degrees F and not more than 75 degrees F has been and continues to be maintained in the work area for seven days prior to and during installation and continuously thereafter.

C. Provide protective clothing and equipment to ensure the protection of the workmen and building during the course of the work.

D. Dispose of stripper, solvent, stain finish waste and other chemicals and debris in accordance with state, municipal and federal regulations.

E. Ensure that no lead or other hazardous materials are present in the historic materials and conform with local, state, and federal regulations for protection of workers, and for any containment, collection, handling, and disposal of hazardous materials which may be found.

F. Ensure these will be provided or provide as required for integrity of materials and for workers mechanical ventilation, fire extinguishers, protective clothing, and other items as required to ensure the health and safety of workers and the security and safety of the building fabric.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

A. Where any manufacturer makes more than one grade of each material specified, use the highest grade of each type, whether or not the material is mentioned by trade name in these Specifications.

B. Follow manufacturer's instructions regarding preparation of surfaces, mixing, applying, drying, and other requirements. In case of conflict with this Specification, the more stringent shall govern.

C. Materials shall be new, of the highest grade (other than salvaged and reused historic materials), free from defects, and of recent manufacture. Where product names and numbers are indicated and are not available, furnish products, which are equal to original Specifications, as approved and at no additional cost to the Owner.

2.2 PERFORMANCE REQUIREMENTS

A. New finish on existing historic wood panels to be Class A.

2.3 ARCHITECTURAL WOODWORK, GENERAL REQUIREMENTS

A. The grades of all materials under this Section shall be as defined by the rules of the recognized association of lumber manufacturers producing the materials specified. Wood for millwork shall conform to, or exceed, the requirements of "Premium Grade, Class 1 " as established by Quality Standards of the Architectural Woodwork Institute (AWI) and shall be provided in the cuts and figure required to match existing historic wood. Where conflicts occur between these standards and this Specification, the more stringent requirement shall govern in each case.

B. Lumber and finished woodwork throughout shall be of sound stock, thoroughly seasoned, free from all knots, and if new, kiln–dried to a moisture content not exceeding 6 to 11 percent for millwork.

C. Work that is to be finished shall be free from defects or blemishes on surfaces exposed to view that will show after the transparent stain finish coat is applied. Any materials which are in any way defective and do not meet specifications for quality and grade, or are otherwise not in proper condition, shall be rejected.

D. All glues shall be non–staining wood glues.

2.4 SOURCE LIMITATIONS

A. Source Limitations: Engage a qualified historic architectural woodworking firm to assume undivided responsibility for production of historic interior architectural woodwork and new woodwork to match including paneling, ornamental woodwork, wood trim, wood doors faced with veneers from same flitches as paneling and associated door frames and trim.

2.5 WOOD MATERIALS

A. Existing Wood: Doors, door frames, door trim, casings, chair rails, baseboards, and other ornamental woodwork indicated such as pediments over doors, and stile and rail paneling at locations shown on Drawings.

B. Repair and Replacement Wood: To match the existing wood species as nearly as possible.

1. Existing species is thought to be Mahogany, which cannot be obtained and used for this work. Use Sapele, which is the nearest species match. An experienced and skilled craftsmen knowledgeable in this kind of work will achieve a very close finish and appearance match after ascertaining the original woodwork cuts and matching those.
2. Carefully strip existing lacquer and finish on historic woodwork in a manner that does not harm the wood or alter its surface texture. Refinish with clear satin finish based on Samples approved by Architect.
3. New Wood to Match: Provide new finished wood with surfaces prepared as required to receive stained finish in order to match the appearance of the existing stained finish including texture, color, translucence, and sheen.
4. Work includes as many iterative repetitions as needed using a number of wood Samples and stain formulations to arrive at a close match in appearance to the finish of the historic woodwork.
5. Sequence sampling and matching work so that matching of new woodwork and that of refinished historic woodwork is assured and approved. Do not begin refinishing historic woodwork until a satisfactory and consistent match is achieved.

2.6 REPAIR MATERIALS

A. Surface Preparation Materials:

1. Sandpaper, sanding screens, sanding blocks, corner scrapers, dental tools, and other materials as required, of the size and shape necessary to remove the stain finish build-up without damage to the substrate.

2. Chemical Stripper: Solvent based, non-alkaline commercial paint stripper.

B. Solvents: Toluene, acetone, butyl acetate, mineral spirits, or turpentine as determined most effective.

C. Accessory Materials: Linseed oil, dryers, thinners, pigments, and other materials as required to complete the work of the best quality available.

D. Cleaning Accessories: Clean cotton waste and soft natural bristle brushes.

E. Dutchman Adhesive and Painted Wood Filler: Two-part epoxy resin paste wood filler specifically designed to adhere to wood fibers which is non-shrinking and flexible, has a 20-minute pot life, and can be carved and sanded, such as Abatron, Inc. "WoodEpox", AMI "Amwood", West Epoxy System or approved equal.

F. General Adhesive: White, waterproof wood glue, complying with ASTM C3110, "Specification for Adhesive Wood in Non-Structural Glued Wood Products."

G. Wood Stain: Penetrating, permanent oil-based stain, color to match existing historic architectural woodwork as approved by Architect.

H. Clear Finish Wood Filler: Oil based, non-shrinking paste and putty type filler, which can be pigmented to match the stained color of the wood.

I. Wood Clear Finish: One coat sealer and two coats long oil, alkyd resin premium quality satin finish varnish, equal to Benjamin Moore 414 Satin Finish Varnish.

J. Finishing Wax: Paste wax such as Butcher's Paste Wax, manufactured by Butcher Polish Co., Marlborough, MA.

K. Steel Wool: Grade OOO steel wool.

L. Cloths: Clean cotton waste.

M. Miscellaneous Anchors: Nails, screws, and other fasteners of the size and type required for the work.

PART 3 - EXECUTION

3.1 PREPARATION

A. Examine the existing wood condition and verify that the work can be completed as specified. Notify the Architect of any variations in the work from that shown on the Drawings or required herein.

B. Remove and discard all miscellaneous, abandoned anchors, fasteners, drapery hardware, conduit, and other items shown for removal on the Drawings or encountered in the field.

C. Remove and store for reinstallation cover plates, door hardware, anchors, and fasteners noted to remain in the area of the work. Retain screws and fasteners for reuse. Label all as to the location of removal.

D. Provide full protection for surrounding materials, such as glass, bronze, aluminum, and marble which could be damaged by the work of this section.

E. Before installation, condition historic architectural woodwork to humidity conditions in installation areas for not less than 72 hours prior to beginning of installation.

F. Before installing historic architectural woodwork, examine shop-fabricated work for completion and complete work as required, including removal of packing and back-priming of concealed surfaces as applicable.

3.2 CLEAR FINISH REMOVAL

A. Remove wax, dirt, shellac, and varnish from doors, paneling, trim, ornamental and associated historic architectural woodwork, without stripping to bare wood.

B. Using steel wool and solvent, remove old finishes by hand to a sound, smooth wood surface. Replace soiled steel wool frequently with clean and continue the wiping process until a smooth evenly colored surface is achieved. Use no water on wood surface under any circumstances. Rub only in the direction of the grain of the wood. If the solvent affects the stained color of the wood, discontinue use, and use an alternative solvent.

C. Work in a small area, 12-inch square at a time. Work area must be within a comfortable arms reach. Remove finish from all areas, including corners and moldings equally to form an evenly cleaned and evenly colored surface.

D. Do not scratch or gouge the wood, round corners or edges or alter molding profiles.

E. Allow the wood to dry completely prior to finishing, no less than 24 hours.

3.3 WOOD REPAIR

A. Replace severely damaged, missing or altered wood, moldings and trim, by piecing in new wood which precisely matches the color, grain, size and profile of the existing. Replace damaged wood only as absolutely necessary. The intent is to retain the maximum amount of original fabric as is possible. Comply with AWI Premium Grade.

B. Fill small holes, less than 1/2-inch in size, open joints, splits, and deep scratches/gouges with non-shrinking wood putty filler, colored to match the final finished color of the wood. Form and sand filler to conform with the surrounding surfaces.

C. Fill holes in wood larger than 1/2-inch with new wood cut to fit the opening precisely. Wood patches shall match the grain and color of the immediately surrounding wood. Prior to patching, cut the edges of the damaged area square to make the repair as inconspicuous as possible. Joints between old and new wood with clear finishes shall be no greater than 0.5mm. Glue wood patches/dutchman with epoxy adhesive. Fill joint with wood filler as for small hole repair.

D. Glue and nail any loose trim, reset loose fasteners, and replace any missing nails or fasteners. Set and fill nail holes at all locations as required.

3.4 CLEAR FINISH

A. Sand wood to smooth raised grain and rough edges. Apply stain to wood and repairs to match original color. Stain wood only as required to even the color.

B. Fill and seal the wood. Apply varnish in a minimum of two coats. Apply without runs or drips in even coatings of consistent thickness. Sand between coats to produce a smooth, unblemished finish.

C. Allow sufficient time between coats to permit proper drying.

D. Provide a finish free of laps, cloudiness, color irregularity, runs, brush marks, nail holes or other imperfections.

E. Remove and refinish work not in compliance with specified requirements and accepted Samples.

3.5 INSTALLATION OF HISTORIC AND NEW REPLICATED WOODWORK

A. Discard prepared units of replication material which are unsound, warped, bowed, twisted, improperly treated, not adequately seasoned, or too small to fabricate work with a minimum of joints or optimum jointing arrangements, or which are of defective manufacture with respect to surfaces, sizes, or patterns.

B. Install any new work plumb, level, true, and straight with no distortions. Shim as required using concealed shims. Install to a tolerance of 1/8 inch in 8 feet for plumb and level work; and with 1/32 inch maximum offset in flush adjoining surfaces and 1/16 inch maximum offsets in revealed adjoining surfaces.

C. Standing and Running Trim: Install with minimum number of joints possible, using full-length pieces to the greatest extent possible.

D. Install historic architectural woodwork, architectural woodwork to match, historic attached accoutrements, and install coordinated with other work as required, in accordance with approved mock-ups.

E. Refinish or finish all woodwork in accordance with approved mock-ups.

3.6 PROTECTION

A. As work proceeds and upon completion, promptly remove all dust and debris. Keep work area free of debris and excess materials, tools, and equipment.

B. Install protection at the completed work to keep clean and free of damage by other trades until substantial completion and final acceptance of the work.

C. At completion, leave work areas clean and free of materials and debris. Remove protective coverings and remove residue resulting from same.

3.7 CLEAN UP

A. Leave the removal site free of all debris at the end of each working day.

B. Work and adjacent areas shall be clean and free of all loose materials, debris, and surplus adhesives and other products.

C. Repair damaged and defective historic architectural woodwork work wherever possible to eliminate defects functionally and visually; where not possible to repair properly, inform Architect and replace woodwork as acceptable to Architect. Adjust joinery and other factors of installation for uniform appearance. Restore any marred or damaged areas using approved means at no expense to Owner.

D. Clean historic architectural woodwork and woodwork to match on exposed and semi-exposed surfaces.

3.8 FIELD QUALITY CONTROL

A. Architect's Project Representatives: Architect will assign Project representatives to carry out Architect's responsibilities at the site, including observing progress and quality of portions of the work completed. Allow Architect's Project representatives use of lift devices and scaffolding, as needed, to observe progress and quality of portion of the work completed.

B. Notify Architect's Project representatives in advance of times when lift devices and scaffolding will be relocated. Do not relocate lift devices and scaffolding until Architect's Project representatives have had reasonable opportunity to observe work areas at lift device or scaffold location.

3.9 WOOD AND OTHER MATERIALS WASTE DISPOSAL

A. Salvageable Materials: Unless otherwise indicated, excess wood materials are Contractor's property.

B. Wood Waste: Remove wood waste and legally dispose of off Owner's property.

C. Waste from cleaners, patching materials, adhesives, and other materials used in work: Remove waste and legally dispose of off Owner's property.

END OF SECTION

SECTION 06 10 00 - ROUGH CARPENTRY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Wood products.
2. Fire-retardant-treated lumber.
3. Miscellaneous lumber.
4. Plywood backing panels.

B. Related Requirements:

1. Section 061600 "Sheathing" for sheathing, subflooring, and underlayment.

1.2 DEFINITIONS

A. Boards or Strips: Lumber of less than 2 inches nominal size in least dimension.

B. Dimension Lumber: Lumber of 2 inches nominal size or greater but less than 5 inches nominal size in least dimension.

C. Lumber grading agencies, and abbreviations used to reference them, include the following:

1. NeLMA: Northeastern Lumber Manufacturers' Association.
2. NLGA: National Lumber Grades Authority.
3. SPIB: The Southern Pine Inspection Bureau.
4. WCLIB: West Coast Lumber Inspection Bureau.
5. WWPA: Western Wood Products Association.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.

1. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Include physical properties of treated materials based on testing by a qualified independent testing agency.
2. For fire-retardant treatments, include physical properties of treated lumber both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency in accordance with ASTM D5664.

B. Sustainable Design Submittals:

1. Chain-of-Custody Qualification Data: For manufacturer and vendor.

C. Delegated-Design Submittal: For roof edge and parapet coping nailers, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 QUALITY ASSURANCE

A. Certified Wood: Provide an invoice including vendor's chain-of-custody number, product cost, and entity being invoiced.

B. Vendor Qualifications: A vendor that is certified for chain of custody by an FSC-accredited certification body.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Stack wood products flat with spacers beneath and between each bundle to provide air circulation. Protect wood products from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design roof edge and parapet nailer attachments.

1. Structural Loads:

a. Wind Loads: As indicated on Drawings.

2. Design roof edge and parapet coping nailer attachment to withstand bending, shear, or other stresses imparted by indicated project wind loads, fastener-resistance loads, and in accordance with ANSI/SPRI ED-1, Tables A6 and A7.

2.2 WOOD PRODUCTS

A. Regional Materials: Manufacture wood products within 100 miles of Project site from materials that have been extracted, harvested, or recovered, as well as manufactured, within 100 miles of Project site.

B. Lumber: Comply with DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, comply with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Grade lumber by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.

1. Factory mark each piece of lumber with grade stamp of grading agency.

2. Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry wood products.
3. Dress lumber, S4S, unless otherwise indicated.

C. Maximum Moisture Content:

1. Boards: 19 percent.
2. Dimension Lumber: 19 percent unless otherwise indicated.

2.3 FIRE-RETARDANT-TREATED LUMBER

A. General: Where fire-retardant-treated materials are indicated, materials are to comply with requirements in this article, that are acceptable to authorities having jurisdiction, and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.

B. Fire-Retardant-Treated Lumber and Plywood by Pressure Process: Products with a flame-spread index of 25 or less when tested in accordance with ASTM E84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet beyond the centerline of the burners at any time during the test.

1. Treatment is not to promote corrosion of metal fasteners.
2. Interior Type A: Treated materials are to have a moisture content of 28 percent or less when tested in accordance with ASTM D3201/D3201M at 92 percent relative humidity. Use where exterior type is not indicated.
3. Design Value Adjustment Factors: Treated lumber is to be tested according to ASTM D5664 and design value adjustment factors are to be calculated according to ASTM D6841.

C. Kiln-dry lumber after treatment to maximum moisture content of 19 percent. Kiln-dry plywood after treatment to maximum moisture content of 15 percent.

D. Identify fire-retardant-treated wood with appropriate classification marking of qualified testing agency and other information required by authorities having jurisdiction.

E. Application: Treat all rough carpentry unless otherwise indicated.

2.4 MISCELLANEOUS LUMBER

A. Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:

1. Blocking.
2. Nailers.

B. Dimension Lumber Items: Construction or No. 2 grade lumber.

C. Roofing Nailers: Structural- or No. 2-grade lumber or better; kiln-dried Douglas fir, southern pine, or wood having similar decay-resistant properties.

D. For blocking not used for attachment of other construction, Utility, Stud, or No. 3 grade lumber of any species may be used provided that it is cut and selected to eliminate defects that will interfere with its attachment and purpose.

2.5 PLYWOOD BACKING PANELS

A. Equipment Backing Panels: Plywood, DOC PS 1, Exterior, A-C, fire-retardant treated, in thickness indicated or, if not indicated, not less than 3/4-inch nominal thickness.

2.6 FASTENERS

A. General: Fasteners are to be of size and type indicated and comply with requirements specified in this article for material and manufacture. Provide nails or screws, in sufficient length, to penetrate not less than 1-1/2 inches into wood substrate.

B. Nails, Brads, and Staples: ASTM F1667.

C. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.

D. Post-Installed Anchors: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC193 or ICC-ES AC308 as appropriate for the substrate.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Framing Standard: Comply with AF&PA's WCD 1, "Details for Conventional Wood Frame Construction," unless otherwise indicated.

B. Set work to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry accurately to other construction. Locate nailers, blocking, and similar supports to comply with requirements for attaching other construction.

C. Install plywood backing panels by fastening to studs; coordinate locations with utilities requiring backing panels. Install fire-retardant-treated plywood backing panels with classification marking of testing agency exposed to view.

D. Do not splice structural members between supports unless otherwise indicated.

E. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.

F. Sort and select lumber so that natural characteristics do not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of member or pieces that are too small to use with minimum number of joints or optimum joint arrangement.

G. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:

1. Table 2304.10.1, "Fastening Schedule," in ICC's International Building Code (IBC).
2. ICC-ES evaluation report for fastener.

H. Securely attach roofing nailers to substrates by anchoring and fastening to withstand bending, shear, or other stresses imparted by Project wind loads and fastener-resistance loads as designed in accordance with ASCE/SEI 7.

I. Use steel common nails unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood. Drive nails snug but do not countersink nail heads unless otherwise indicated.

3.2 INSTALLATION OF WOOD BLOCKING AND NAILERS

A. Install where indicated and where required for attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.

B. Attach wood blocking to substrates to support applied loading. Recess bolts and nuts flush with surfaces unless otherwise indicated.

C. Attach wood roofing nailers securely to substrate to resist the designed outward and upward wind loads indicated on Drawings and in accordance with ANSI/SPRI ED-1, Tables A6 and A7.

END OF SECTION

This page is intentionally left blank.

SECTION 06 16 00 - SHEATHING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Wall sheathing.
2. Parapet sheathing.
3. Subflooring and underlayment.
4. Sheathing joint-and-penetration treatment materials.

B. Related Requirements:

1. Section 061000 "Rough Carpentry" for plywood backing panels.

1.2 ACTION SUBMITTALS

A. Product Data:

1. Wall sheathing.
2. Parapet sheathing.
3. Subflooring and underlayment.
4. Sheathing joint-and-penetration treatment materials.

B. Sustainable Design Submittals:

1. Chain-of-Custody Certificates: For certified wood products. Include statement of costs.
2. Chain-of-Custody Qualification Data: For manufacturer and vendor.
3. Laboratory Test Reports: For composite wood products, indicating compliance with requirements for low-emitting materials.
4. Product Data: For installation adhesives, indicating VOC content.
5. Laboratory Test Reports: For installation adhesives, indicating compliance with requirements for low-emitting materials.

1.3 QUALITY ASSURANCE

A. Certified Wood: Provide an invoice including vendor's chain-of-custody number, product cost, and entity being invoiced.

B. Vendor Qualifications: A vendor that is certified for chain of custody by an FSC-accredited certification body.

PART 2 - PRODUCTS

2.1 WOOD PANEL PRODUCTS

A. Emissions: Products are to meet the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

B. Certified Wood: Label the following wood products in accordance with the AF&PA's Sustainable Forestry Initiative, certify as "FSC Pure" in accordance with FSC STD-01-001 and FSC STD-40-004, or certify and label in accordance with the standards of the Programme for the Endorsement of Forest Certification.

1. Plywood.

C. Thickness: As needed to comply with requirements specified, but not less than thickness indicated.

D. Factory mark panels to indicate compliance with applicable standard.

2.2 FIRE-RETARDANT-TREATED PLYWOOD

A. General: Where fire-retardant-treated materials are indicated, use materials complying with requirements in this article that are acceptable to authorities having jurisdiction and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.

B. Fire-Retardant-Treated Plywood by Pressure Process: Products with a flame-spread index of 25 or less when tested in accordance with ASTM E84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet beyond the centerline of the burners at any time during the test.

1. Use treatment that does not promote corrosion of metal fasteners.
2. Exterior Type: Treated materials are to comply with requirements specified above for fire-retardant-treated plywood by pressure process after being subjected to accelerated weathering in accordance with ASTM D2898. Use for exterior locations and where indicated.

C. Kiln-dry material after treatment to a maximum moisture content of 15 percent. Do not use material that is warped or does not comply with requirements for untreated material.

D. Identify fire-retardant-treated plywood with appropriate classification marking of qualified testing agency.

E. Application: Treat all plywood unless otherwise indicated.

2.3 WALL SHEATHING

A. Glass-Mat Gypsum Sheathing, Walls: ASTM C1177/C1177M.

1. Products: Subject to compliance with requirements, provide one of the following:

    a. Certainteed; SAINT-GOBAIN; CertainTeed GlasRoc Type X Sheathing.
    b. Georgia-Pacific Gypsum LLC.; DensGlass Sheathing.
    c. Gold Bond Building Products, LLC provided by National Gypsum Company; Gold Bond® eXP® Fire-Shield® Sheathing.
    d. USG Corporation; Securock.

2. Type and Thickness: Type X, 5/8 inch thick.

2.4 PARAPET SHEATHING

A. Glass-Mat Gypsum Sheathing: ASTM C1177/C1177M to match substrate board specified in Section 07 54 19 “Polyvinyl-Chloride (PVC) Roofing.”.

2.5 SUBFLOORING AND UNDERLAYMENT

A. Plywood Combination Subfloor-Underlayment: DOC PS 1, Exposure 1, Structural I, Underlayment single-floor panels.

1. Span Rating: Not less than 16.
2. Nominal Thickness: Not less than 23/32 inch.
3. Edge Detail: Tongue and groove.
4. Surface Finish: Fully sanded face.

2.6 FASTENERS

A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.

1. For parapet and wall sheathing, provide fasteners with organic-polymer or other corrosion-protective coating having a salt-spray resistance of more than 800 hours in accordance with ASTM B117.

B. Nails, Brads, and Staples: ASTM F1667.

C. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.

D. Screws for Fastening Sheathing to Wood Framing: ASTM C1002.

E. Screws for Fastening Wood Structural Panels to Cold-Formed Metal Framing: ASTM C954, except with wafer heads and reamer wings, length as recommended by screw manufacturer for material being fastened.

F. Screws for Fastening Gypsum Sheathing to Cold-Formed Metal Framing: Steel drill screws, in length recommended by sheathing manufacturer for thickness of sheathing to be attached.

1. For steel framing from 0.033 to 0.112 inch thick, use screws that comply with ASTM C954.

2.7 SHEATHING JOINT-AND-PENETRATION TREATMENT MATERIALS

A. Sealant for Glass-Mat Gypsum Sheathing: Silicone emulsion sealant complying with ASTM C834, compatible with sheathing tape and sheathing and recommended by tape and sheathing manufacturers for use with glass-fiber sheathing tape and for covering exposed fasteners.

1. Sheathing Tape: Self-adhering glass-fiber tape, minimum 2 inches wide, 10 by 10 or 10 by 20 threads/inch, of type recommended by sheathing and tape manufacturers for use with silicone emulsion sealant in sealing joints in glass-mat gypsum sheathing and with a history of successful in-service use.

2.8 MISCELLANEOUS MATERIALS

A. Adhesives for Field Gluing Panels to Wood Framing: Formulation complying with APA AFG-01 that is approved for use with type of construction panel indicated by manufacturers of both adhesives and panels.

1. Verify adhesive has a VOC content of 50 g/L or less.
2. Verify adhesive complies with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Do not use materials with defects that impair quality of sheathing or pieces that are too small to use with minimum number of joints or optimum joint arrangement. Arrange joints so that pieces do not span between fewer than three support members.

B. Cut panels at penetrations, edges, and other obstructions of work; fit tightly against abutting construction unless otherwise indicated.

C. Securely attach to substrate by fastening as indicated, complying with the following:

1. Table 2304.10.1, "Fastening Schedule," in the ICC's International Building Code.
2. ICC-ES evaluation report for fastener.

D. Use common wire nails unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections. Install fasteners without splitting wood.

E. Coordinate wall and parapet sheathing installation with flashing and joint-sealant installation so these materials are installed in sequence and manner that prevent exterior moisture from passing through completed assembly.

F. Do not bridge building expansion joints; cut and space edges of panels to match spacing of structural support elements.

G. Coordinate sheathing installation with installation of materials installed over sheathing so sheathing is not exposed to precipitation or left exposed at end of the workday when rain is forecast.

3.2 INSTALLATION OF WOOD STRUCTURAL PANEL

A. General: Comply with applicable recommendations in APA Form No. E30, "Engineered Wood Construction Guide," for types of structural-use panels and applications indicated.

B. Fastening Methods: Fasten panels as indicated below:

1. Combination Subfloor-Underlayment:

a. Glue and nail to wood framing.
b. Space panels 1/8 inch apart at edges and ends.

3.3 INSTALLATION OF GYPSUM SHEATHING

A. Comply with GA-253 and with manufacturer's written instructions.

1. Fasten gypsum sheathing to cold-formed metal framing with screws.
2. Install panels with a 3/8-inch gap where non-load-bearing construction abuts structural elements.
3. Install panels with a 1/4-inch gap where they abut masonry or similar materials that might retain moisture, to prevent wicking.

B. Apply fasteners so heads bear tightly against face of sheathing, but do not cut into facing.

C. Vertical Installation: Install vertical edges centered over studs. Abut ends and edges with those of adjacent panels. Attach at perimeter and within field of panel to each stud.

1. Space fasteners approximately 8 inches o.c. and set back a minimum of 3/8 inch from edges and ends of panels.

D. Seal sheathing joints in accordance with sheathing manufacturer's written instructions and air-barrier manufacturer’s written instructions using one of the following:

1. Apply elastomeric sealant to joints and fasteners and trowel flat. Apply sufficient amount of sealant to completely cover joints and fasteners after troweling. Seal other penetrations and openings.
2. Apply glass-fiber sheathing tape to glass-mat gypsum sheathing joints and apply and trowel sealant to embed entire face of tape in sealant. Apply sealant to exposed fasteners with a trowel so fasteners are completely covered. Seal other penetrations and openings.

END OF SECTION

This page is intentionally left blank.

SECTION 06 40 23 - INTERIOR ARCHITECTURAL WOODWORK

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Interior standing and running trim for transparent finish.
2. Interior standing and running trim for opaque finish.
3. Interior frames and jambs for transparent finish.
4. Miscellaneous materials.
5. Shop priming.
6. Shop finishing.

B. Related Requirements:

1. Section 061000 "Rough Carpentry" for wood furring, blocking, shims, and hanging strips required for installing interior architectural woodwork that are concealed within other construction before interior architectural woodwork installation.
2. Section 064214 "Stile and Rail Wood Paneling" for transparent finished interior paneling for indicated wood species, cut, and finish to match.
3. Section 064400 "Ornamental Woodwork" for interior millwork exposed to view to match wood species, cut, and finish that is not specified in this Section.
4. Section 081416 "Flush Wood Doors" and Section 081433 "Stile and Rail Wood Doors" for fire-rated wood door frames of wood species, cut, and finish to match that require testing with fire-rated doors.

1.2 COORDINATION

A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections, to ensure that interior architectural woodwork can be supported and installed as indicated.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data:

1. Anchors.
2. Adhesives.
3. Shop finishing materials.

B. Sustainable Design Submittals:

1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.
2. Chain-of-Custody Certificates: For certified wood products. Include statement of costs.
3. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting materials.
4. Laboratory Test Reports: For composite wood products, indicating compliance with requirements for low-emitting materials.

C. Shop Drawings:

1. Include the following:

a. Dimensioned plans, elevations, and sections.
b. Attachment details.

2. Show large-scale details.
3. Show locations and sizes of furring, blocking, and hanging strips, including blocking and reinforcement concealed by construction and specified in other Sections.

D. Samples for Verification: For the following:

1. Lumber for Transparent Finish: Not less than 5 inches wide by 12 inches long, for each species and cut, finished on one side and one edge.
2. Veneer Leaves: Representative of and selected from flitches to be used for transparent-finished interior architectural woodwork.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For architectural woodwork manufacturer.

B. Product Certificates: For the following:

1. Composite wood products.
2. Adhesives.

1.6 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Employs skilled workers who custom fabricate products similar to those required for this Project and whose products have a record of successful in-service performance.

1. Manufacturer's Certification: Licensed participant in AWI's Quality Certification Program.
2. Installer Qualifications: Manufacturer of products.

B. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.

1. Build mockups of typical interior architectural woodwork as shown on Drawings as part of room mockups specified in Section 014339 “Mockups.”.

2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Owner specifically approves such deviations by Change Order.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Comply with the Architectural Woodwork Standards, Section 2.

B. Do not deliver interior architectural woodwork until painting and similar finish operations that might damage woodwork have been completed in installation areas.

C. Store woodwork in installation areas or in areas where environmental conditions comply with requirements specified in "Field Conditions" Article.

1. Handle and store fire-retardant-treated wood to comply with chemical treatment manufacturer's written instructions.

1.8 FIELD CONDITIONS

A. Environmental Limitations without Humidity Control: Do not deliver or install interior architectural woodwork until building is enclosed, wet-work is complete, and HVAC system is operating and maintaining temperature and relative humidity at levels designed for building occupants for the remainder of the construction period.

B. Established Dimensions: Where interior architectural woodwork is indicated to fit to other construction, establish dimensions for areas where woodwork is to fit. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Source Limitations: Engage a qualified woodworking firm to assume undivided responsibility for production of interior architectural woodwork, paneling, wood-veneer-faced architectural cabinets, ornamental woodwork, wood trim and wood doors faced with veneers from same flitches as paneling.

2.2 PERFORMANCE REQUIREMENTS

A. Fire-Rated Frames: Complying with NFPA 80 and listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction for fire-protection ratings indicated on Drawings, based on testing at positive pressure in accordance with NFPA 252 or UL 10C.

1. Smoke- and Draft-Control Assemblies: Listed and labeled for smoke and draft control by a qualified testing agency acceptable to authorities having jurisdiction, based on testing in accordance with UL 1784 and installed in compliance with NFPA 105.

B. Fire-Rated, Borrowed-Lite Assemblies: Complying with NFPA 80 and listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing in accordance with NFPA 257 or UL 9.

2.3 WOODWORK, GENERAL

A. Quality Standard: Unless otherwise indicated, comply with the Architectural Woodwork Standards for grades of interior architectural woodwork indicated for construction, finishes, installation, and other requirements.

1. Provide certificates from AWI certification program indicating that woodwork complies with requirements of grades specified.
2. The Contract Documents may contain requirements that are more stringent than the Architectural Woodwork Standards. Comply with Contract Documents and Architectural Woodwork Standards.

B. Regional Materials: To the extent required to comply with the minimum criteria specified in Section 01 81 13.14 “Sustainable Design Requirements,” manufacture wood products within 100 miles of Project site from materials that have been extracted, harvested, or recovered, as well as manufactured, within 100 miles of Project site.

C. Certified Wood: Certify wood products as "FSC Pure" or "FSC Mixed Credit" in accordance with FSC STD-01-001 and FSC STD-40-004.

2.4 INTERIOR STANDING AND RUNNING TRIM FOR TRANSPARENT FINISH

A. Architectural Woodwork Standards Grade: Premium.

B. Hardwood Lumber:

1. Wood Species and Cut: Match species and cut indicated for other types of transparent-finished architectural wood paneling and ornamental woodwork located in same area of building unless otherwise indicated.
2. Wood Moisture Content: 5 to 10 percent.
3. For trim items including base use veneered construction.

2.5 INTERIOR STANDING AND RUNNING TRIM FOR OPAQUE FINISH

A. Architectural Woodwork Standards Grade: Premium.

1. Wood Species: Any closed-grain hardwood.
2. Wood Moisture Content: 5 to 10 percent.

2.6 INTERIOR FRAMES AND JAMBS FOR TRANSPARENT FINISH

A. Architectural Woodwork Standards Grade: Premium.

B. Wood Species and Cut: Match species and cut indicated for other types of transparent-finished architectural woodwork located in same area of building unless otherwise indicated.

1. Wood Moisture Content: 5 to 10 percent.

C. For frames or jambs use veneered construction.

D. Fire-Rated Interior Frames and Jambs: Products fabricated from fire-retardant particleboard or fire-retardant MDF with veneered exposed surfaces and listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing in accordance with NFPA 252.

1. Fire Rating: As indicated on Drawings.

2.7 HARDWOOD SHEET MATERIALS

A. Composite Wood Products: Provide materials that comply with requirements of the Architectural Woodwork Standards for each type of interior architectural woodwork and quality grade specified unless otherwise indicated.

1. Recycled Content of MDF and Particleboard: Provide products with postconsumer recycled content plus one-half of preconsumer recycled content to the extent required to comply with the minimum criteria specified in Section 01 81 13.14 “Sustainable Design Requirements.”
2. Composite Wood Products: Verify products are made using ultra-low-emitting formaldehyde resins, as defined in the California Air Resources Board's "Airborne Toxic Control Measure to Reduce Formaldehyde Emissions from Composite Wood Products," or are made with no added formaldehyde.
3. Medium-Density Fiberboard (MDF): ANSI A208.2, Grade 130.
4. Particleboard: ANSI A208.1, Grade M-2.
5. Veneer-Faced Panel Products (Hardwood Plywood): HPVA HP-1.

2.8 MISCELLANEOUS MATERIALS

A. Provide self-drilling screws for metal-framing supports, as recommended by metal-framing manufacturer.

B. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage.

C. Adhesives: Use adhesives that meet the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

D. Installation Adhesive: Product recommended by fabricator for each substrate for secure anchorage.

1. Verify adhesives have a VOC content of 70 g/L or less.

2. Verify adhesive complies with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

2.9 FABRICATION

A. Fabricate interior architectural woodwork to dimensions, profiles, and details indicated.

1. Ease edges to radius indicated for the following:

a. Edges of Solid-Wood (Lumber) Members: 1/16 inch unless otherwise indicated.

B. Complete fabrication, including assembly, to maximum extent possible before shipment to Project site.

1. Disassemble components only as necessary for shipment and installation.
2. Where necessary for fitting at site, provide allowance for scribing, trimming, and fitting.

2.10 SHOP PRIMING

A. Preparations for Finishing: Comply with the Architectural Woodwork Standards for sanding, filling countersunk fasteners, sealing concealed surfaces, and similar preparations for finishing interior architectural woodwork, as applicable to each unit of work.

B. Interior Architectural Woodwork for Opaque Finish: Shop prime with one coat of wood primer as specified in Section 09 91 23 "Interior Painting."

1. Backpriming: Apply one coat of primer, compatible with finish coats, to concealed surfaces of woodwork.

2.11 SHOP FINISHING

A. Finish interior architectural woodwork with transparent finish at fabrication shop. Defer only final touchup, cleaning, and polishing until after installation.

B. Preparation for Finishing: Comply with Architectural Woodwork Standards, Section 5 for sanding, filling countersunk fasteners, sealing concealed surfaces, and similar preparations for finishing interior architectural woodwork, as applicable to each unit of work.

1. Backpriming: Apply one coat of sealer or primer, compatible with finish coats, to concealed surfaces of interior architectural woodwork. Apply two coats to end-grain surfaces.

C. Transparent Finish:

1. Architectural Woodwork Standards Grade: Premium.
2. Finish System:

a. 11: Polyurethane, Catalyzed.

3. Staining: Clear, no stain.
4. Open Finish for Open-Grain Woods: Do not apply filler to open-grain woods.
5. Sheen: Satin, 20 percent.

PART 3 - EXECUTION

3.1 PREPARATION

A. Before installation, condition interior architectural woodwork to humidity conditions in installation areas for not less than 72 hours prior to beginning of installation.

B. Before installing interior architectural woodwork, examine shop-fabricated work for completion and complete work as required, including removal of packing and backpriming of concealed surfaces.

3.2 INSTALLATION

A. Grade: Install interior architectural woodwork to comply with same grade as item to be installed.

B. Assemble interior architectural woodwork and complete fabrication at Project site to the extent that it was not completed during shop fabrication.

C. Install interior architectural woodwork level, plumb, true in line, and without distortion.

1. Shim as required with concealed shims.
2. Install level and plumb to a tolerance of 1/8 inch in 96 inches.

D. Scribe and cut interior architectural woodwork to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.

E. Anchor interior architectural woodwork to anchors or blocking built in or directly attached to substrates.

1. Secure with countersunk, concealed fasteners and blind nailing.
2. Use fine finishing nails for exposed fastening, countersunk and filled flush with interior architectural woodwork.
3. For shop-finished items, use filler matching finish of items being installed.

F. Standing and Running Trim:

1. Install with minimum number of joints possible, using full-length pieces (from maximum length of lumber available) to greatest extent possible.
2. Do not use pieces less than 96 inches long, except where shorter single-length pieces are necessary.
3. Scarf running joints and stagger in adjacent and related members.
4. Fill gaps, if any, between top of base and wall with latex sealant, painted to match wall.
5. Install standing and running trim with no more variation from a straight line than 1/8 inch in 96 inches.

3.3 REPAIR

A. Repair damaged and defective interior architectural woodwork, where possible, to eliminate functional and visual defects and to result in interior architectural woodwork being in compliance with requirements of Architectural Woodwork Standards for the specified grade.

B. Where not possible to repair, replace defective woodwork.

C. Shop Finish: Touch up finishing work specified in this Section after installation of interior architectural woodwork.

1. Fill nail holes with matching filler where exposed.
2. Apply specified finish coats, including stains and paste fillers if any, to exposed surfaces where only sealer/prime coats are shop applied.

D. Field Finish: See Section 099123 "Interior Painting" for final finishing of installed interior architectural woodwork not indicated to be shop finished.

3.4 CLEANING

A. Clean interior architectural woodwork on exposed and semiexposed surfaces.

END OF SECTION

SECTION 06 41 13 - WOOD-VENEER-FACED ARCHITECTURAL CABINETS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Wood cabinets for transparent finish.
2. Wood materials.
3. Cabinet hardware and accessories.
4. Miscellaneous materials.
5. Shop finishing.

B. Related Requirements:

1. Section 061000 "Rough Carpentry" for wood furring, blocking, shims, and hanging strips required for installing cabinets that are concealed within other construction before cabinet installation.
2. Section 064023 “Interior Architectural Woodwork” for transparent finish interior standing and running trim to match finish on wood-veneer-faced architectural cabinets.
3. Section 064214 “Stile and Rail Wood Paneling” for transparent finish paneling including panel products from flitches matching wood-veneer-faced architectural cabinets.
4. Section 064400 “Ornamental Woodwork” for transparent finish ornamental millwork items including panel products from flitches matching wood-veneer-faced architectural cabinets.

1.2 COORDINATION

A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to support loads imposed by installed and fully loaded cabinets.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data:

1. Wood cabinets for transparent finish.
2. Wood materials.
3. Cabinet hardware and accessories.
4. Miscellaneous materials.
5. Shop finishing.

B. Product Data Submittals: For each product.

C. Sustainable Design Submittals:

1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.
2. Chain-of-Custody Certificates: For certified wood products. Include statement of costs.
3. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting materials.
4. Laboratory Test Reports: For composite wood products, indicating compliance with requirements for low-emitting materials.

D. Shop Drawings: For architectural cabinets.

1. Include plans, elevations, sections, and attachment details.
2. Show large-scale details.
3. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections.
4. Show locations and sizes of cutouts and holes for items installed in architectural cabinets.
5. Show veneer leaves with dimensions, grain direction, exposed face, and identification numbers indicating the flitch and sequence within the flitch for each leaf.

E. Samples for Verification: For the following:

1. Lumber for Transparent Finish: Not less than 5 inches wide by 12 inches long, for each species and cut, finished on one side and one edge.
2. Veneer Leaves: Representative of and selected from flitches to be used for transparent-finished cabinets.
3. Corner Pieces:

    a. Cabinet-front frame joints between stiles and rails and at exposed end pieces, 18 inches high by 18 inches wide by 6 inches deep.
    b. Miter joints for standing trim.

4. Exposed Cabinet Hardware and Accessories: One full-size unit for each type and finish.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer.

B. Product Certificates: For each type of product.

1.6 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Employs skilled workers who custom fabricate products similar to those required for this Project and whose products have a record of successful in-service performance.

1. Manufacturer's Certification: Licensed participant in AWI's Quality Certification Program.

B. Installer Qualifications: Manufacturer of products.

C. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.

1. Build mockups of typical architectural cabinets as shown on Drawings as part of room mockups specified in Section 014339 “Mockups.”
2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Do not deliver cabinets until painting and similar finish operations that might damage architectural cabinets have been completed in installation areas. Store cabinets in installation areas or in areas where environmental conditions comply with requirements specified in "Field Conditions" Article.

1.8 FIELD CONDITIONS

A. Environmental Limitations without Humidity Control: Do not deliver or install cabinets until building is enclosed, wet-work is complete, and HVAC system is operating and maintaining temperature and relative humidity at levels planned for building occupants during the remainder of the construction period.

B. Established Dimensions: Where cabinets are indicated to fit to other construction, establish dimensions for areas where cabinets are to fit. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

PART 2 - PRODUCTS

2.1 ARCHITECTURAL CABINETS

A. Source Limitations: Engage a qualified woodworking firm to assume responsibility for production of architectural cabinets with sequence-matched wood veneered stile and rail wood paneling, wood doors with face veneers that are sequence matched with architectural cabinets, and transparent-finished wood doors that are required to be of same species as architectural cabinets.

2.2 CABINETS, GENERAL

A. Quality Standard: Unless otherwise indicated, comply with the Architectural Woodwork Standards for grades of architectural cabinets indicated for construction, finishes, installation, and other requirements.

1. Provide certificates from AWI certification program indicating that woodwork and installation complies with requirements of grades specified.

2. The Contract Documents may contain requirements that are more stringent than the referenced woodwork quality standard. Comply with requirements of Contract Documents in addition to those of the referenced quality standard.

2.3 WOOD CABINETS FOR TRANSPARENT FINISH

A. Architectural Woodwork Standards Grade: Premium.

B. Regional Materials: To the extent required to comply with the minimum criteria specified in Section 01 81 13.14 “Sustainable Design Requirements,” manufacture wood products within 100 miles of Project site from materials that have been extracted, harvested, or recovered, as well as manufactured, within 100 miles of Project site.

C. Certified Wood: Certify wood products as "FSC Pure" or "FSC Mixed Credit" in accordance with FSC STD-01-001 and FSC STD-40-004.

D. Type of Construction: Face frame.

E. Door and Drawer-Front Style: Stile and rail, reveal overlay as indicated on Drawings.

1. Reveal Dimension: As indicated on Drawings.

F. Wood for Exposed Surfaces: As indicated on Drawings.

1. Species, Flitch, and Cut: As preselected and indicated in Finish Schedule.
2. Grain Direction: As indicated on Drawings.
3. Matching of Veneer Leaves: Book match.
4. Veneer Matching within Panel Face: Center-balance match.
5. Veneer Matching within Room: Provide cabinet veneers in each room or other space from a single flitch with doors, drawer fronts, and other surfaces matched in a sequenced set with continuous match where veneers are interrupted perpendicular to the grain.

G. Semiexposed Surfaces:

1. Surfaces Other Than Drawer Bodies: Compatible species to that indicated for exposed surfaces, stained to match.
2. Drawer Subfronts, Backs, and Sides: Solid-hardwood lumber, stained to match species indicated for exposed surfaces.
3. Drawer Bottoms: Hardwood plywood.

H. Dust Panels: 1/4-inch plywood or tempered hardboard above compartments and drawers unless located directly under tops.

I. Drawer Construction: Fabricate with exposed fronts fastened to subfront with mounting screws from interior of body.

1. Join subfronts, backs, and sides with glued rabbeted joints supplemented by mechanical fasteners or glued dovetail joints.

2.4 WOOD MATERIALS

A. Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of architectural cabinet and quality grade specified unless otherwise indicated.

1. Wood Moisture Content: 5 to 10 percent.

B. Composite Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of architectural cabinet and quality grade specified unless otherwise indicated.

1. Recycled Content of MDF and Particleboard: Provide products with postconsumer recycled content plus one-half of preconsumer recycled content to the extent required to comply with the minimum criteria specified in Section 01 81 13.14 “Sustainable Design Requirements.”
2. Composite Wood Products: Verify products are made using ultra-low-emitting formaldehyde resins, as defined in the California Air Resources Board's "Airborne Toxic Control Measure to Reduce Formaldehyde Emissions from Composite Wood Products," or are made with no added formaldehyde.

3. Medium-Density Fiberboard (MDF): ANSI A208.2, Grade 130.
4. Particleboard (Medium Density): ANSI A208.1, Grade M-2.
5. Veneer-Faced Panel Products (Hardwood Plywood): HPVA HP-1.

2.5 CABINET HARDWARE AND ACCESSORIES

A. Cabinet Hardware: Provide cabinet hardware and accessory materials associated with architectural cabinets except for items specified in Section 08 71 00 "Door Hardware."

B. Frameless Concealed Hinges (European Type): ANSI/BHMA A156.9, B01602, 135 degrees of opening, self-closing.

C. Pulls: Drop edge, solid metal, 200 mm (7-7/8 inch) long, 35 mm (1-3/8 inch) deep, 21 mm (13/16 inch) tall; brushed brass.

1. Basis-of-Design Product: Subject to compliance with requirement, provide **Doug Mockett & Company, Inc.; DP269B** or comparable product.

D. Shelf Rests: ANSI/BHMA A156.9, B04013; metal.

E. Drawer Slides: ANSI/BHMA A156.9.

1. Standard Duty (Grade 1 and Grade 2): Side mount.
2. Heavy-Duty (Grade 1HD-100 and Grade 1HD-200): Side mount.

    a. Type: Full extension.
    b. Material: Zinc-plated ball bearing slides.
    c. Motion Feature: Self-closing mechanism.

3. Standard Duty (Grade 1 and Grade 2): Side mount.
4. Heavy-Duty (Grade 1HD-100 and Grade 1HD-200): Side mount.

    a. Type: Full extension.
    b. Material: Zinc-plated ball bearing slides.
    c. Motion Feature: Self-closing mechanism.

5. Pencil drawers not more than 3 inches high and not more than 24 inches wide, provide 50 lb load capacity.

6. General-purpose drawers more than 3 inches high, but not more than 6 inches high and not more than 24 inches wide, provide 75 lb load capacity.
7. File drawers more than 6 inches high or more than 24 inches wide, provide 100 lb load capacity.
8. Lateral file drawers more than 6 inches high and more than 24 inches but not more than 30 inches wide, provide 150 lb load capacity.
9. Lateral file drawers more than 6 inches high and more than 30 inches wide, provide 200 lb load capacity.
10. Computer keyboard tray, provide 75 lb load capacity.

F. Door Locks: ANSI/BHMA A156.11, E07121.

G. Drawer Locks: ANSI/BHMA A156.11, E07041.

H. Door and Drawer Silencers: ANSI/BHMA A156.16, L03011.

I. Grommets for Cable Passage: 2-inch OD, molded-plastic grommets and matching plastic caps with slot for wire passage.

1. Color: As selected by Architect from manufacturer’s full range of colors.

J. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with ANSI/BHMA A156.18 for BHMA finish number indicated.

1. Satin Brass, Clear Coated: ANSI/BHMA 606 for brass base; ANSI/BHMA 633 for steel base.

K. For concealed hardware, provide manufacturer's standard finish that complies with product class requirements in ANSI/BHMA A156.9.

2.6 MISCELLANEOUS MATERIALS

A. Furring, Blocking, Shims, and Hanging Strips: Fire-retardant-treated softwood lumber, kiln-dried to less than 15 percent moisture content.

B. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide metal expansion sleeves or expansion bolts for post-installed anchors. Use nonferrous-metal or hot-dip galvanized anchors and inserts at inside face of exterior walls and at floors.

C. Adhesives: Use adhesives that meet the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

2.7 FABRICATION

A. Fabricate architectural cabinets to dimensions, profiles, and details indicated. Ease edges and corners to 1/16-inch radius unless otherwise indicated.

B. Complete fabrication, including assembly and hardware application, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for

shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.

C. Shop-cut openings to maximum extent possible to receive hardware, appliances, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.

2.8 SHOP FINISHING

A. Finish architectural cabinets at manufacturer's shop as specified in this Section. Defer only final touchup, cleaning, and polishing until after installation.

B. Preparation for Finishing: Comply with referenced quality standard for sanding, filling countersunk fasteners, sealing concealed surfaces, and similar preparations for finishing architectural cabinets, as applicable to each unit of work.

1. Backpriming: Apply one coat of sealer or primer, compatible with finish coats, to concealed surfaces of cabinets.

C. Transparent Finish:

1. Architectural Woodwork Standards Grade: Premium.
2. Finish: System - 11, catalyzed polyurethane.
3. Wash Coat for Closed-Grain Woods: Apply wash-coat sealer to cabinets made from closed-grain wood before staining and finishing.
4. Staining: Clear, no stain.
5. Open Finish for Open-Grain Woods: Do not apply filler to open-grain woods.
6. Sheen: 20 percent satin.

PART 3 - EXECUTION

3.1 PREPARATION

A. Before installation, condition cabinets to humidity conditions in installation areas for not less than 72 hours.

3.2 INSTALLATION

A. Architectural Woodwork Standards Grade: Install cabinets to comply with quality standard grade of item to be installed.

B. Assemble cabinets and complete fabrication at Project site to extent that it was not completed in the shop.

C. Anchor cabinets to anchors or blocking built in or directly attached to substrates. Secure with countersunk, concealed fasteners and blind nailing. Use fine finishing nails or finishing screws for exposed fastening, countersunk and filled flush with cabinet surface.

1. For shop-finished items, use filler matching finish of items being installed.

D. Install cabinets level, plumb, and true in line to a tolerance of 1/8 inch in 96 inches using concealed shims.

1. Scribe and cut cabinets to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.
2. Install cabinets without distortion so doors and drawers fit openings and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete installation of hardware and accessory items as indicated.
3. Maintain veneer sequence matching of cabinets with transparent finish.
4. Unless otherwise indicated, fasten wall cabinets through back, near top and bottom, and at ends not more than 16 inches o.c. with No. 10 wafer-head screws sized for not less than 1-1/2-inch penetration into wood framing, blocking, or hanging strips.

E. Shop Finishes: Touch up finishing after installation of architectural cabinets. Fill nail holes with matching filler.

1. Apply specified finish coats, including stains and paste fillers if any, to exposed surfaces where only sealer/prime coats are shop applied.

3.3 ADJUSTING AND CLEANING

A. Repair damaged and defective cabinets, where possible, to eliminate functional and visual defects. Where not possible to repair, replace architectural cabinets. Adjust joinery for uniform appearance.

B. Clean, lubricate, and adjust hardware.

C. Clean cabinets on exposed and semiexposed surfaces. Touch up finishes to restore damaged or soiled areas.

END OF SECTION

SECTION 06 41 16 - PLASTIC-LAMINATE-CLAD ARCHITECTURAL CABINETS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Plastic-laminate-clad architectural cabinets.
2. Cabinet hardware and accessories.
3. Miscellaneous materials.

B. Related Requirements:

1. Section 123623.13 "Plastic-Laminate-Clad Countertops."

1.2 COORDINATION

A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to support loads imposed by installed and fully loaded cabinets.

1.3 ACTION SUBMITTALS

A. Product Data:

1. Plastic-laminate-clad architectural cabinets.
2. Cabinet hardware and accessories.
3. Miscellaneous materials.

B. Sustainable Design Submittals:

1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.
2. Chain-of-Custody Certificates: For certified wood products. Include statement of costs.
3. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting materials.
4. Laboratory Test Reports: For composite wood products, indicating compliance with requirements for low-emitting materials.

C. Shop Drawings:

1. Include plans, elevations, sections, and attachment details.
2. Show large-scale details.
3. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections.

4. Show locations and sizes of cutouts and holes for items installed in plastic-laminate architectural cabinets.

D. Samples for Verification: For the following:

1. Plastic Laminates: 12 by 12 inches, for each type, color, pattern, and surface finish required.

a. Provide one sample applied to core material with specified edge material applied to one edge.

2. Thermally Fused Laminate (TFL) Panels: 12 by 12 inches, for each color, pattern, and surface finish.

a. Provide edge banding on one edge.

3. Exposed Cabinet Hardware and Accessories: One full-size unit for each type and finish.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer and Installer.

B. Product Certificates: For the following:

1. Composite wood products.
2. Thermally fused laminate panels.
3. High-pressure decorative laminate.
4. Adhesives.

1.5 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Employs skilled workers who custom fabricate products similar to those required for this Project and whose products have a record of successful in-service performance.

B. Installer Qualifications: Manufacturer of products.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Do not deliver cabinets until painting and similar finish operations that might damage architectural cabinets have been completed in installation areas. Store cabinets in installation areas or in areas where environmental conditions comply with requirements specified in "Field Conditions" Article.

1.7 FIELD CONDITIONS

A. Environmental Limitations without Humidity Control: Do not deliver or install cabinets until building is enclosed, wet-work is complete, and HVAC system is operating and maintaining

temperature and relative humidity at levels planned for building occupants during the remainder of the construction period.

B. Established Dimensions: Where cabinets are indicated to fit to other construction, establish dimensions for areas where cabinets are to fit. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

PART 2 - PRODUCTS

2.1 PLASTIC-LAMINATE-CLAD ARCHITECTURAL CABINETS

A. Quality Standard: Unless otherwise indicated, comply with the Architectural Woodwork Standards for grades of cabinets indicated for construction, finishes, installation, and other requirements.

1. Provide certificates from AWI certification program indicating that woodwork and installation complies with requirements of grades specified.

2. The Contract Documents may contain requirements that are more stringent than the referenced quality standard. Comply with requirements of Contract Documents in addition to those of the referenced quality standard.

B. Architectural Woodwork Standards Grade: Custom.

C. Regional Materials: To the extent required to comply with the minimum criteria specified in Section 01 81 13.14 “Sustainable Design Requirements,” manufacture wood products within 100 miles of Project site from materials that have been extracted, harvested, or recovered, as well as manufactured, within 100 miles of Project site.

D. Certified Wood: Certify wood products as "FSC Pure" or "FSC Mixed Credit" in accordance with FSC STD-01-001 and FSC STD-40-004.

E. Type of Construction: Frameless.

F. Door and Drawer-Front Style: Flush overlay.

G. High-Pressure Decorative Laminate: ISO 4586-3, grades as indicated or if not indicated, as required by quality standard.

H. Exposed Surfaces:

1. Plastic-Laminate Grade: HGS.
2. Edges: Grade HGS.
3. Pattern Direction: As indicated.

I. Semiexposed Surfaces:

1. Surfaces Other Than Drawer Bodies: Thermally fused laminate panels.

a. Edges of Thermally Fused Laminate Panel Shelves: PVC or polyester edge banding.

b. For semiexposed backs of panels with exposed plastic-laminate surfaces, provide surface of high-pressure decorative laminate, ISO 4586-3, grade to match exposed surface.

2. Drawer Sides and Backs: Thermally fused laminate panels.
3. Drawer Bottoms: Thermally fused laminate panels.

J. Concealed Backs of Panels with Exposed Plastic-Laminate Surfaces: High-pressure decorative laminate, ISO 4583-3, grade to match exposed surface.

K. Drawer Construction: Fabricate with exposed fronts fastened to subfront with mounting screws from interior of body.

1. Join subfronts, backs, and sides with glued rabbeted joints supplemented by mechanical fasteners or glued dovetail joints.

L. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:

1. As preselected and indicated in Finish Schedule.

2.2 WOOD MATERIALS

A. Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of architectural cabinet and quality grade specified unless otherwise indicated.

1. Wood Moisture Content: 5 to 10 percent.

B. Composite Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of architectural cabinet and quality grade specified unless otherwise indicated.

1. Recycled Content of MDF and Particleboard: Provide products with postconsumer recycled content plus one-half of preconsumer recycled content to the extent required to comply with the minimum criteria specified in Section 01 81 13.14 “Sustainable Design Requirements.”
2. Composite Wood Products: Verify products are made using ultra-low-emitting formaldehyde resins, as defined in the California Air Resources Board's "Airborne Toxic Control Measure to Reduce Formaldehyde Emissions from Composite Wood Products," or are made with no added formaldehyde.
3. Medium-Density Fiberboard (MDF): ANSI A208.2, Grade 130.
4. Particleboard (Medium Density): ANSI A208.1, Grade M-2-Exterior Glue.
5. Thermally Fused Laminate (TFL) Panels: Particleboard or MDF finished with thermally fused, melamine-impregnated decorative paper and complying with requirements of ISO 4586.

2.3 CABINET HARDWARE AND ACCESSORIES

A. Cabinet Hardware: Provide cabinet hardware and accessory materials associated with architectural cabinets except for items specified in Section 08 71 00 "Door Hardware."

B. Frameless Concealed Hinges (European Type): ANSI/BHMA A156.9, B01602, 135 degrees of opening, self-closing.

C. Pulls: Drop edge, solid metal, 200 mm (7-7/8 inch) long, 35 mm (1-3/8 inch) deep, 21 mm (13/16 inch) tall; brushed brass.

1. Basis-of-Design Product: Subject to compliance with requirement, provide **Doug Mockett & Company, Inc.; DP269B** or comparable product.

D. Shelf Rests: ANSI/BHMA A156.9, B04013; metal.

E. Drawer Slides: ANSI/BHMA A156.9.

1. Standard Duty (Grade 1 and Grade 2): Side mount.
2. Heavy-Duty (Grade 1HD-100 and Grade 1HD-200): Side mount.

a. Type: Full extension.
b. Material: Zinc-plated ball bearing slides.
c. Motion Feature: Self-closing mechanism.

3. Pencil drawers not more than 3 inches high and not more than 24 inches wide, provide 50 lb load capacity.
4. General-purpose drawers more than 3 inches high, but not more than 6 inches high and not more than 24 inches wide, provide 75 lb load capacity.
5. File drawers more than 6 inches high or more than 24 inches wide, provide 100 lb load capacity.
6. Lateral file drawers more than 6 inches high and more than 24 inches but not more than 30 inches wide, provide 150 lb load capacity.
7. Lateral file drawers more than 6 inches high and more than 30 inches wide, provide 200 lb load capacity.
8. Computer keyboard tray, provide 75 lb load capacity.

F. Door Locks: ANSI/BHMA A156.11, E07121.

G. Drawer Locks: ANSI/BHMA A156.11, E07041.

H. Door and Drawer Silencers: ANSI/BHMA A156.16, L03011.

I. Grommets for Cable Passage: 2-inch OD, molded-plastic grommets and matching plastic caps with slot for wire passage.

1. Color: As selected by Architect from manufacturer’s full range of colors.

J. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with ANSI/BHMA A156.18 for ANSI/BHMA finish number indicated.

1. Satin Brass, Clear Coated: ANSI/BHMA 606 for brass base; ANSI/BHMA 633 for steel base.

K. For concealed hardware, provide manufacturer's standard finish that complies with product class requirements in ANSI/BHMA A156.9.

2.4 MISCELLANEOUS MATERIALS

A. Furring, Blocking, Shims, and Hanging Strips: Fire-retardant-treated softwood lumber, kiln-dried to less than 15 percent moisture content.

B. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide metal expansion sleeves or expansion bolts for post-installed anchors. Use nonferrous-metal or hot-dip galvanized anchors and inserts at inside face of exterior walls and at floors.

C. Adhesives: Use adhesives that meet the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

2.5 FABRICATION

A. Fabricate architectural cabinets to dimensions, profiles, and details indicated.

B. Complete fabrication, including assembly and hardware application, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.

C. Shop-cut openings to maximum extent possible to receive hardware, appliances, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.

PART 3 - EXECUTION

3.1 PREPARATION

A. Before installation, condition cabinets to humidity conditions in installation areas for not less than 72 hours.

3.2 INSTALLATION

A. Architectural Woodwork Standards Grade: Install cabinets to comply with quality standard grade of item to be installed.

B. Assemble cabinets and complete fabrication at Project site to extent that it was not completed in the shop.

C. Anchor cabinets to anchors or blocking built in or directly attached to substrates. Secure with wafer-head cabinet installation screws.

D. Install cabinets level, plumb, and true in line to a tolerance of 1/8 inch in 96 inches using concealed shims.

1. Scribe and cut cabinets to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.
2. Install cabinets without distortion so doors and drawers fit openings and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete installation of hardware and accessory items as indicated.
3. Fasten wall cabinets through back, near top and bottom, and at ends not more than 16 inches o.c. with No. 10 wafer-head sheet metal screws through metal backing or metal framing behind wall finish.

3.3 ADJUSTING AND CLEANING

A. Repair damaged and defective cabinets, where possible, to eliminate functional and visual defects. Where not possible to repair, replace architectural cabinets. Adjust joinery for uniform appearance.

B. Clean, lubricate, and adjust hardware.

C. Clean cabinets on exposed and semiexposed surfaces.

END OF SECTION

This page is intentionally left blank.

SECTION 06 42 14 - STILE AND RAIL WOOD PANELING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Stile and rail wood paneling for transparent finish.
2. Fire-retardant-treated materials.
3. Installation materials.

B. Related Requirements:

1. Section 06 01 40.99 “Relocation, Reuse, and Restoration of Historic Courtroom Woodwork” for new stile and rail wood paneling to match existing historic courtroom woodwork.

1.2 COORDINATION

A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that paneling can be installed as indicated.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include data for fire-retardant treatment from chemical-treatment manufacturer and certification by treating plant that treated materials comply with requirements.

B. Sustainable Design Submittals:

1. Chain-of-Custody Certificates: For certified wood products. Include statement of costs.
2. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting materials.
3. Laboratory Test Reports: For composite wood products, indicating compliance with requirements for low-emitting materials.
4. Product Data: For installation adhesives, indicating VOC content.
5. Laboratory Test Reports: For installation adhesives, indicating compliance with requirements for low-emitting materials.

C. Shop Drawings: For stile and rail wood paneling.

1. Include plans, elevations, sections, and attachment details.
2. Show details full size.
3. Show locations and sizes of furring and blocking, including concealed blocking specified in other Sections.
4. For paneling veneered in fabrication shop, show veneer leaves with dimensions, grain direction, exposed face, and identification numbers indicating the flitch and sequence within the flitch for each leaf.

D. Samples for Verification: For the following:

1. Lumber for Transparent Finish: Not less than 5 inches wide by 12 inches long, for each species and cut, finished on one side and one edge.
2. Veneer Leaves: Representative of and selected from flitches to be used for transparent-finished paneling.
3. Veneer-Faced Panel Products for Transparent Finish: 12 by 24 inches, for each species and cut. Include at least one face-veneer seam and finish as specified.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For fabricator.

B. Product Certificates: For each type of product.

C. Evaluation Reports: For fire-retardant-treated materials, from ICC-ES.

1.6 QUALITY ASSURANCE

A. Fabricator Qualifications: Shop that employs skilled workers who custom-fabricate products similar to those required for this Project and whose products have a record of successful in-service performance.

B. Shop Certification: AWI's Quality Certification Program accredited participant.

C. Installer Qualifications: Fabricator of products.

1.7 MOCKUPS

A. Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.

1. Build mockups of typical stile and rail wood paneling. Provide one full-size, full-height, full-width mockup of Historic Courtroom panel and one full-size, full-height, full-width mockup of new Appellate Court paneling. Coordinate requirements with those for Room Mockups specified in Section 01 43 39 “Mockups.”
2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Do not deliver paneling until painting and similar operations that might damage paneling have been completed in installation areas. Store paneling in installation areas or in areas where environmental conditions comply with requirements specified in "Field Conditions" Article.

1.9 FIELD CONDITIONS

A. Environmental Limitations without Humidity Control: Do not deliver or install paneling until building is enclosed, wet-work is complete, and HVAC system is operating and will maintain temperature and relative humidity at levels planned for building occupants during the remainder of the construction period.

B. Field Measurements: Where paneling is indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1. Locate concealed framing, blocking, and reinforcements that support paneling by field measurements before being enclosed/concealed by construction, and indicate measurements on Shop Drawings.

C. Established Dimensions: Where paneling is indicated to fit to other construction, establish dimensions for areas where woodwork is to fit. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Source Limitations: Engage a qualified woodworking firm to assume undivided responsibility for production of paneling, wood-veneer-faced architectural cabinets, ornamental woodwork, wood trim and wood doors faced with veneers from same flitches as paneling.

2.2 PANELING, GENERAL

A. Quality Standard: Unless otherwise indicated, comply with the "Architectural Woodwork Standards" for grades of stile and rail wood paneling (stile and rail wall surfacing) indicated for construction, finishes, installation, and other requirements.

1. Provide inspections of fabrication and installation together with labels and certificates from AWI certification program indicating that woodwork complies with requirements of grades specified.
2. The Contract Documents may contain requirements that are more stringent than the referenced woodwork quality standard. Comply with requirements of Contract Documents in addition to those of the referenced quality standard.

2.3 STILE AND RAIL WOOD PANELING FOR TRANSPARENT FINISH

A. Grade: Premium.

B. Regional Materials: To the extent required to comply with the minimum criteria specified in Section 01 81 13.14 “Sustainable Design Requirements,” manufacture wood products within 100 miles of Project site from materials that have been extracted, harvested, or recovered, as well as manufactured, within 100 miles of Project site.

C. Certified Wood: Certify wood products as "FSC Pure" or "FSC Mixed Credit" in accordance with FSC STD-01-001 and FSC STD-40-004.

D. Wood Species and Flitch: As preselected and indicated in Finish Schedule.

E. Stiles and Rails: Stiles and rails of veneered construction with edges banded or with lumber moldings, as indicated, to conceal core and veneer joints.

F. Panels: Flat panels.

G. Blueprint Matched Insert Panels: Blueprint matched in a horizontal sequence for adjacent panels, with continuous vertical matching between adjacent panels. Book, balance, and center match face-veneer leaves within each panel.

1. Location: At full height wood paneled wall behind judges’ benches at fourth floor courtrooms.

H. Book and Balance Matched Insert Panels: Book and balance match face veneers within panels. Harmonious matching is required between adjacent panels; select and arrange panels for similarity of grain pattern and color between adjacent panels.

1. Location: Typical, unless noted otherwise.

I. Shop assemble stile and rail paneling into largest units practical for delivery and installation. Provide shop-prepared detachable joints for necessary field connections. Sand and pull joints tight in shop so field joints will comply with joint tolerances for specified grade. Unless otherwise indicated, provide continuous mortise-and-tenon joints between panel units and provide removable temporary protection for joints during handling and delivery.

1. Outside Corner of Stile and Rail Paneling: Shop prepare using lock-mitered or mitered-and-splined construction. Assemble, sand, and glue in shop if site conditions permit.

2.4 MATERIALS

A. Materials, General: Provide materials that comply with requirements of referenced quality standard for each quality grade specified unless otherwise indicated.

B. Wood Moisture Content: 5 to 10 percent.

C. Composite Wood Products: Provide materials that comply with requirements of referenced quality standard for each quality grade specified unless otherwise indicated.

1. Recycled Content of MDF and Particleboard: Provide products with postconsumer recycled content plus one-half of preconsumer recycled content to the extent required to

comply with the minimum criteria specified in Section 01 81 13.14 “Sustainable Design Requirements.”

2. Composite Wood Products: Verify products are made using ultra-low-emitting formaldehyde resins, as defined in the California Air Resources Board's "Airborne Toxic Control Measure to Reduce Formaldehyde Emissions from Composite Wood Products," or are made with no added formaldehyde.
3. MDF: ANSI A208.2, Grade 130.
4. Particleboard: ANSI A208.1, Grade M-2.
5. Veneer-Faced Panel Products (Hardwood Plywood): HPVA HP-1.

D. Adhesives: Use adhesives that meet the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

2.5 FIRE-RETARDANT-TREATED MATERIALS

A. Fire-Retardant-Treated Materials, General: Where fire-retardant-treated materials are indicated, use materials that are acceptable to authorities having jurisdiction, and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.

1. Use treated materials that comply with requirements of referenced quality standard. Do not use materials that are warped, discolored, or otherwise defective.
2. Use fire-retardant-treatment formulations that do not bleed through or otherwise adversely affect finishes. Do not use colorants to distinguish treated materials from untreated materials.
3. Identify fire-retardant-treated materials with appropriate classification marking of qualified testing agency in the form of removable paper label or imprint on surfaces that will be concealed from view after installation.

B. Fire-Retardant-Treated Lumber and Plywood: Products with a flame-spread index of 25 or less when tested according to ASTM E84, with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet beyond the centerline of the burners at any time during the test.

1. Kiln-dry lumber and plywood after treatment to a maximum moisture content of 19 and 15 percent, respectively.
2. For items indicated to receive a stained or natural finish, use organic resin chemical formulation.
3. Mill lumber before treatment and implement procedures during treatment and drying processes that prevent lumber from warping and developing discolorations from drying sticks or other causes, marring, and other defects affecting appearance of paneling.

C. Fire-Retardant Particleboard: Made from softwood particles and fire-retardant chemicals mixed together at time of panel manufacture to achieve flame-spread index of 25 or less and smoke-developed index of 25 or less per ASTM E84.

1. For panels 3/4 inch thick and less, comply with ANSI A208.1 for Grade M-2 except for the following minimum properties: modulus of rupture, 1600 psi; modulus of elasticity, 300,000 psi; internal bond, 80 psi; and screw-holding capacity on face and edge, 250 and 225 lbf, respectively.

2. For panels 13/16 to 1-1/4 inches thick, comply with ANSI A208.1 for Grade M-1 except for the following minimum properties: modulus of rupture, 1300 psi; modulus of elasticity, 250,000 psi; linear expansion, 0.50 percent; and screw-holding capacity on face and edge, 250 and 175 lbf, respectively.

D. Fire-Retardant Fiberboard: Medium-density fiberboard (MDF) panels complying with ANSI A208.2, made from softwood fibers, synthetic resins, and fire-retardant chemicals mixed together at time of panel manufacture to achieve flame-spread index of 25 or less and smoke-developed index of 200 or less per ASTM E84.

2.6 INSTALLATION MATERIALS

A. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide metal expansion sleeves or expansion bolts for post-installed anchors. Use nonferrous-metal or hot-dip galvanized anchors and inserts at inside face of exterior walls.

B. Installation Adhesive: Product recommended by panel fabricator for each substrate for secure anchorage.

1. Verify adhesives have a VOC content of 70 g/L or less.
2. Verify adhesive complies with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

2.7 FABRICATION

A. Sand fire-retardant-treated wood lightly to remove raised grain on exposed surfaces before fabrication.

B. Arrange paneling in shop or other suitable space in proposed sequence for examination by Architect. Mark units with temporary sequence numbers to indicate position in proposed layout.

1. Lay out one elevation at a time if approved by Architect.
2. Notify Architect seven days in advance of the date and time when layout will be available for viewing.
3. Provide lighting of similar type and level as that of final installation for viewing layout unless otherwise approved by Architect.
4. Rearrange paneling as directed by Architect until layout is approved.
5. Do not trim end units and other nonmodular-size units to less than modular size until after Architect's approval of layout. Indicate trimming by masking edges of units with nonmarking material.
6. Obtain Architect's approval of layout before start of assembly. Mark units and Shop Drawings with assembly sequence numbers based on approved layout.

C. Complete fabrication, including assembly, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.

1. Notify Architect seven days in advance of the dates and times paneling fabrication will be complete.

2. Trial fit assemblies at fabrication shop that cannot be shipped completely assembled. Install dowels, screws, bolted connectors, and other fastening devices that can be removed after trial fitting. Verify that parts fit as intended and check measurements of assemblies against field measurements indicated on approved Shop Drawings before disassembling for shipment.

D. Shop cut openings, to maximum extent possible, to receive hardware, appliances, plumbing fixtures, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.

2.8 SHOP FINISHING

A. Finishing:

1. Finish all paneling at fabrication shop as specified in this Section. Defer only final touchup, cleaning, and polishing until after installation.

B. Preparation for Finishing: Comply with referenced quality standard for sanding, filling countersunk fasteners, sealing concealed surfaces, and similar preparations for finishing paneling, as applicable to each unit of work.

1. Backpriming: Apply two coats of sealer or primer, compatible with finish coats, to concealed surfaces of paneling.

C. Transparent Finish:

1. Grade: Premium.
2. Finish: System - 11, catalyzed polyurethane.
3. Staining:

a. At Historic Courtroom: As required to match existing.
b. All other locations: Clear, no stain.

4. Open Finish for Open-Grain Woods: Do not apply filler to open-grain woods.
5. Sheen: 20 percent, satin.

PART 3 - EXECUTION

3.1 PREPARATION

A. Before installation, condition paneling to humidity conditions in installation areas.

B. Before installing paneling, examine shop-fabricated work for completion and complete work as required, including removal of packing and backpriming.

3.2 INSTALLATION

A. Grade: Install paneling to comply with quality standard grade of paneling to be installed.

B. Install paneling level, plumb, true in line, and without distortion. Shim as required with concealed shims. Install level and plumb to a tolerance of 1/8 inch in 96 inches. Install with no more than 1/16 inch in 96-inch vertical cup or bow and 1/8 inch in 96-inch horizontal variation from a true plane.

C. Scribe and cut paneling to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.

D. Anchor paneling to supporting substrate with concealed panel-hanger clips.

1. Do not use face fastening unless covered by trim.

E. Complete finishing work specified in this Section to extent not completed at shop or before installation of paneling. Fill nail holes with matching filler where exposed.

1. Apply specified finish coats, including stains and paste fillers if any, to exposed surfaces where only sealer/prime coats are shop applied.

3.3 ADJUSTING AND CLEANING

A. Repair damaged and defective paneling, where possible, to eliminate functional and visual defects. Where not possible to repair, replace paneling. Adjust for uniform appearance.

B. Clean paneling on exposed surfaces. Touch up shop-applied finishes to restore damaged or soiled areas.

END OF SECTION

SECTION 06 44 00 - ORNAMENTAL WOODWORK

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Interior ornamental woodwork for transparent finish including, but not limited to, the following:

    a. Attorney's Tables.
    b. Spectator Rail.
    c. Judge's bench.
    d. Lectern.
    e. Pediment heads.
    f. Pilasters.
    g. Security Desk.

2. Shop finishing of interior ornamental woodwork.

B. Related Requirements:

1. Section 06 01 40.99 "Relocation, Reuse, and Restoration of Historic Courtroom Woodwork" for relocation and restoration of existing stile and rail wood paneling, Judges' Bench, and Gallery Rail, including carved ornamentation, cornice molding, dentil course, and carved and turned newel and balusters; all setting the basis for wood species, cut, and finish matching.
2. Section 06 10 00 "Rough Carpentry" for wood furring, blocking, shims, and hanging strips required for installing ornamental woodwork that are concealed within other construction before ornamental woodwork installation.
3. Section 06 40 23 for wood standing and running trim and interior frames and jambs of matching wood species, cut, and finish.
4. Section 06 41 13 "Wood-Veneer-Faced Architectural Cabinets" for wood-veneer-faced cabinets of matching wood species, cut, and finish.
5. Section 06 42 14 "Stile and Rail Wood Paneling" for wood paneling of matching wood species, cut, and finish.
6. Section 08 14 16 "Flush Wood Doors" for flush wood doors and fire-rated frames of matching wood species, cut, and finish.
7. Section 08 14 16 "Stile and Rail Wood Doors" for stile and rail wood doors and fire-rated frames of matching wood species, cut, and finish.

1.2 COORDINATION

A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections, to ensure that interior ornamental woodwork can be supported and installed as indicated.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For the following:

1. Composite wood products.
2. Finishing materials and processes.

B. Sustainable Design Submittals:

1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.
2. Chain-of-Custody Certificates: For certified wood products. Include statement of costs.
3. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting materials.
4. Laboratory Test Reports: For composite wood products, indicating compliance with requirements for low-emitting materials.

C. Shop Drawings: Show location of each item, including the following:

1. Dimensioned plans, elevations, and sections.
2. Attachment devices, and other components.
3. Show details at 3 inches equal 1 foot minimum, with ornamentation details drawn at full scale.
4. Show locations and sizes of furring, blocking, and hanging strips, including blocking and reinforcement concealed by construction and specified in other Sections.
5. Show veneer leaves with dimensions, grain direction, exposed face, and identification numbers indicating the flitch and sequence within the flitch for each leaf.
6. Apply AWI Quality Certification Program label to Shop Drawings.

D. Samples for Verification:

1. Lumber for Transparent Finish: Not less than 5 inches wide by 24 inches long, for each species and cut, finished on one side and one edge.
2. Veneer Leaves: Representative of and selected from flitches to be used for transparent-finished ornamental woodwork.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For ornamental woodwork manufacturer.

B. Product Certificates: For the following:

1. Composite wood products.
2. Adhesives.

C. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Quality Standard Compliance Certificates: AWI Quality Certification Program certificates.

1.7 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Employs skilled workers who custom fabricate products similar to those required for this Project and whose products have a record of successful in-service performance.

1. Manufacturer's Certification: Licensed participant in AWI's Quality Certification Program.

B. Installer Qualifications: Manufacturer of products.

C. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution. Coordinate requirements of this Section with those specified in Section 01 43 39 “Mockups” for room mockups.

1. Build full-scale mockups of Spectator Rail, 3-feet-long.
2. Full-scale mockup of portion of Judges’ Bench indicated on Drawings.
3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Owner specifically approves such deviations by Change Order.
4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Comply with Architectural Woodwork Standards, Section 2.

B. Do not deliver interior ornamental woodwork until painting and similar operations that could damage woodwork have been completed in installation areas.

C. Store woodwork in installation areas or in areas where environmental conditions comply with requirements specified in "Field Conditions" Article.

1. Handle and store fire-retardant-treated wood to comply with chemical-treatment manufacturer's written instructions.

1.9 FIELD CONDITIONS

A. Environmental Limitations for Interior Work without Humidity Control: Do not deliver or install interior ornamental woodwork until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature and relative humidity at levels designed for building occupancy for the remainder of the construction period.

B. Established Dimensions: Where ornamental woodwork is indicated to fit to other construction, establish dimensions for areas where woodwork is to fit. Provide allowance for trimming at site,

and coordinate construction to ensure that actual dimensions correspond to established dimensions.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Source Limitations: Engage a qualified woodworking firm to assume undivided responsibility for production of ornamental woodwork, paneling, wood-veneer-faced architectural cabinets, wood trim and wood doors faced all with veneers from same flitches as paneling.

2.2 ORNAMENTAL WOODWORK, GENERAL

A. Quality Standard: Unless otherwise indicated, comply with the Architectural Woodwork Standards for grades of ornamental woodwork indicated for construction, finishes, installation, and other requirements.

1. Provide certificates from AWI certification program indicating that woodwork, including installation, complies with requirements of grades specified.
2. The Contract Documents may contain requirements that are more stringent than the Architectural Woodwork Standards. Comply with Contract Documents and Architectural Woodwork Standards.

B. Regional Materials: To the extent required to comply with the minimum criteria specified in Section 01 81 13.14 “Sustainable Design Requirements,” manufacture wood products within 100 miles of Project site from materials that have been extracted, harvested, or recovered, as well as manufactured, within 100 miles of Project site.

C. Certified Wood: Certify wood products as "FSC Pure" or "FSC Mixed Credit" in accordance with FSC STD-01-001 and FSC STD-40-004.

2.3 INTERIOR ORNAMENTAL WORK FOR TRANSPARENT FINISH

A. Interior ornamental work for transparent finish includes the following:

1. Attorney’s Tables.
2. Spectator Rail.
3. Judge's bench.
4. Lectern.
5. Pediment heads.
6. Pilasters.
7. Security Desk.

B. Architectural Woodwork Standards Grade: Premium.

C. Regional Materials: To the extent required to comply with the minimum criteria specified in Section 01 81 13.14 “Sustainable Design Requirements,” manufacture wood products within 100 miles of Project site from materials that have been extracted, harvested, or recovered, as well as manufactured, within 100 miles of Project site.

D. Certified Wood: Certify wood products as "FSC Pure" or "FSC Mixed Credit" in accordance with FSC STD-01-001 and FSC STD-40-004.

E. Wood Species, Flitch, and Cut: Match species and cut indicated for other types of transparent-finished ornamental woodwork located in same area of building unless otherwise indicated.

1. Species, Flitch, and Cut: As preselected and indicated in Finish Schedule.

F. Wood Moisture Content: 5 to 10 percent.

2.4 WOOD MATERIALS

A. Composite Wood Products: Provide materials that comply with requirements of the Architectural Woodwork Standards for each type of ornamental woodwork and quality grade specified unless otherwise indicated.

1. Recycled Content of MDF and Particleboard: Provide products with postconsumer recycled content plus one-half of preconsumer recycled content to the extent required to comply with the minimum criteria specified in Section 01 81 13.14 “Sustainable Design Requirements.”

B. Composite Wood Products: Verify products are made using ultra-low-emitting formaldehyde resins, as defined in the California Air Resources Board's "Airborne Toxic Control Measure to Reduce Formaldehyde Emissions from Composite Wood Products," or are made with no added formaldehyde.

1. Medium-Density Fiberboard (MDF): ANSI A208.2, Grade 130.
2. Particleboard: ANSI A208.1, Grade M-2.
3. Veneer-Faced Panel Products (Hardwood Plywood): HPVA HP-1.

2.5 FASTENERS

A. General: Provide fasteners of size and type indicated, acceptable to authorities having jurisdiction, and that comply with requirements specified in this article for material and manufacture. Provide nails or screws, in sufficient length, to penetrate not less than 1-1/2 inches into wood substrate.

B. Nails: ASTM F1667.

C. Power-Driven Fasteners: ICC-ES AC70.

D. Wood Screws and Lag Screws: ASME B18.2.1, ASME B18.6.1, or ICC-ES AC233.

E. Carbon-Steel Bolts: ASTM A307 with ASTM A563 hex nuts and, where indicated, flat washers all hot-dip zinc coated.

F. Stainless Steel Bolts: ASTM F593, Alloy Group 1 or 2; with ASTM F594, Alloy Group 1 or 2 hex nuts and, where indicated, flat washers.

G. Postinstalled Anchors: Stainless steel, chemical or torque-controlled expansion anchors with capability to sustain, without failure, a load equal to 6 times the load imposed when installed in

unit masonry assemblies and equal to 4 times the load imposed when installed in concrete as determined by testing in accordance with ASTM E488/E488M conducted by a qualified independent testing and inspecting agency.

1. Stainless steel bolts and nuts complying with ASTM F593 and ASTM F594, Alloy Group 1 or 2.

2.6 BULLET RESISTANT FIBERGLASS MATERIAL

A. Panels shall be made of multiple layers of woven roving ballistic grade fiberglass cloth impregnated with a thermoset polyester resin and compressed into flat rigid sheets and designed to provide the controlled internal delamination to permit the encapture of a penetrating projectile.

1. Thickness and Weight: 7/16-inch maximum thickness and 5 lb/sq. ft. maximum weight.

B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Armortex.
2. Total Security Solutions (TSS).
3. Waco Composites.

2.7 MISCELLANEOUS MATERIALS

A. Adhesives: Use adhesives that meet the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

B. Installation Adhesive: Product recommended by fabricator for each substrate for secure anchorage.

1. Verify adhesives have a VOC content of 70 g/L or less.
2. Verify adhesive complies with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

2.8 FABRICATION

A. Fabricate ornamental woodwork to dimensions, profiles, and details indicated.

1. Ease edges to radius indicated for the following:

a. Edges of Solid-Wood (Lumber) Members: 1/16 inch unless otherwise indicated.

B. Complete fabrication, including assembly and finishing, to maximum extent possible before shipment to Project site.

1. Disassemble components only as necessary for shipment and installation.

2. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.
3. Notify Architect seven days in advance of the dates and times ornamental woodwork fabrication will be complete.
4. Trial fit assemblies at fabrication shop that cannot be shipped completely assembled.

    a. Install dowels, screws, bolted connectors, and other fastening devices that can be removed after trial fitting.
    b. Verify that parts fit as intended, and check measurements of assemblies against field measurements indicated on approved Shop Drawings before disassembling for shipment.

2.9 SHOP FINISHING

A. Finish ornamental woodwork at fabrication shop as specified in this Section. Defer only final touchup, cleaning, and polishing until after installation.

B. Transparent Finish for Interior Items:

1. Architectural Woodwork Standards Grade: Premium.
2. Finish System - 11: Polyurethane, Catalyzed.
3. Staining:

    a. At Historic Courtroom: As required to match existing.
    b. All other locations: Clear, no stain.

4. Open Finish for Open-Grain Woods: Do not apply filler to open-grain woods.
5. Sheen: Satin, 20 percent.

PART 3 - EXECUTION

3.1 PREPARATION

A. Before installation, condition ornamental woodwork to average prevailing humidity conditions in installation areas for not less than 72 hours prior to beginning of installation.

B. Before installing ornamental woodwork, examine shop-fabricated work for completion, and complete work as required, including removing packing and backpriming concealed surfaces.

3.2 INSTALLATION

A. Grade: Install ornamental woodwork to comply with same grade as item to be installed.

B. Assemble ornamental woodwork, and complete fabrication at Project site to the extent that it was not completed during shop fabrication.

C. Install ornamental woodwork level, plumb, true in line, and without distortion.

1. Shim as required with concealed shims.
2. Install level and plumb to a tolerance of 1/8 inch in 96 inches.

D. Scribe and cut ornamental woodwork to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.

E. Anchor ornamental woodwork to anchors or blocking built in or directly attached to substrates.

1. Secure with countersunk, concealed fasteners and blind nailing.
2. Use fine finishing nails or finishing screws for exposed fastening, countersunk and filled flush with ornamental woodwork.
3. For exposed work, arrange fasteners in straight rows parallel with edges of members, with fasteners evenly spaced and with adjacent rows staggered.
4. For shop-finished items, use filler matching finish of items being installed.

3.3 FIELD QUALITY CONTROL

A. Inspections: Provide inspection of installed Work through AWI's Quality Certification Program certifying that woodwork, including installation, complies with requirements of the Architectural Woodwork Standards for the specified grade.

1. Inspection entity is to prepare and submit report of inspection.

3.4 REPAIR

A. Repair damaged and defective ornamental woodwork, where possible, to eliminate functional and visual defects and to result in interior ornamental woodwork being in compliance with requirements of Architectural Woodwork Standards for the specified grade.

B. Where not possible to repair, replace defective Work.

C. Shop Finish: Touch up finishing work specified in this Section after installation of ornamental woodwork.

1. Fill nail holes with matching filler where exposed.
2. Apply specified finish coats, including stains and paste fillers if any, to exposed surfaces where only sealer/prime coats are shop applied.

END OF SECTION

SECTION 06 64 00 - PLASTIC PANELING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Plastic sheet paneling.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:

1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.
2. Product Data: For adhesives, indicating VOC content.
3. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting materials.
4. Product Data: For sealants, indicating VOC content.
5. Laboratory Test Reports: For sealants, indicating compliance with requirements for low-emitting materials.
6. Laboratory Test Reports: For wall materials, indicating compliance with requirements for low-emitting materials.

C. Samples: For plastic paneling and trim accessories, in manufacturer's standard sizes.

1.3 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install plastic paneling until spaces are enclosed and weathertight and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Obtain plastic paneling and trim accessories from single manufacturer.

2.2 PLASTIC SHEET PANELING

A. Glass-Fiber-Reinforced Plastic Paneling: Gelcoat-finished, glass-fiber-reinforced plastic panels complying with ASTM D5319.

1. Basis-of-Design Product: Subject to compliance with requirements, provide **Marlite, Inc.; Standard FRP** or a comparable product by one of the following:

    a. Crane Composites, Inc.
    b. Glasteel.
    c. Newcourt, Inc.
    d. Nudo.
    e. Parkland Plastics.

2. Verify wall materials comply with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
3. Surface-Burning Characteristics: As follows when tested by a qualified testing agency in accordance with ASTM E84. Identify products with appropriate markings of applicable testing agency.

    a. Flame-Spread Index: 25 or less.
    b. Smoke-Developed Index: 450 or less.

4. Nominal Thickness: Not less than 0.09 inch.
5. Surface Finish: Smooth.
6. Color: As selected by Architect from manufacturer's full range.

2.3 ACCESSORIES

A. Trim Accessories: Manufacturer's standard one-piece vinyl extrusions designed to retain and cover edges of panels. Provide division bars, inside corners, outside corners, and caps as needed to conceal edges.

1. Color: Match panels.

B. Concealed Mounting Splines: Continuous, H-shaped aluminum extrusions designed to fit into grooves routed in edges of factory-laminated panels and to be fastened to substrate.

C. Adhesive: As recommended by plastic paneling manufacturer.

1. Verify adhesives have a VOC content of 50 g/L or less.
2. Verify adhesive complies with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

D. Sealant: Mildew-resistant, single-component, neutral-curing or acid-curing silicone sealant recommended by plastic paneling manufacturer and complying with requirements in Section 07 92 00 "Joint Sealants."

1. Verify sealant has a VOC content of 250 g/L or less.

2. Verify sealant complies with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Prepare substrate by sanding high spots and filling low spots as needed to provide flat, even surface for panel installation.

B. Clean substrates of substances that could impair adhesive bond, including oil, grease, dirt, and dust.

C. Condition panels by unpacking and placing in installation space before installation according to manufacturer's written recommendations.

D. Lay out paneling before installing. Locate panel joints where indicated or, if not indicated, to provide equal panels at ends of walls not less than half the width of full panels.

1. Mark plumb lines on substrate at trim accessory locations for accurate installation.
2. Locate trim accessories to allow clearance at panel edges according to manufacturer's written instructions.

3.3 INSTALLATION

A. Install plastic paneling according to manufacturer's written instructions.

B. Install panels in a full spread of adhesive.

C. Install trim accessories with adhesive.

D. Fill grooves in trim accessories with sealant before installing panels, and bed inside corner trim in a bead of sealant.

E. Maintain uniform space between panels and wall fixtures. Fill space with sealant.

F. Remove excess sealant and smears as paneling is installed. Clean with solvent recommended by sealant manufacturer and then wipe with clean dry cloths until no residue remains.

END OF SECTION

SECTION 06 83 13 - FIBER-REINFORCED PLASTIC (FRP) PANELING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Exterior fiber-reinforced plastic (FRP) crown molding and soffits at colonnade.

B. Related Requirements:

1. Section 09 27 13 “Glass-Fiber-Reinforced Gypsum Fabrications” for interior GFRG fabrications.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:

1. Product Data: For adhesives, indicating VOC content.
2. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting materials.
3. Product Data: For sealants, indicating VOC content.
4. Laboratory Test Reports: For sealants, indicating compliance with requirements for low-emitting materials.
5. Laboratory Test Reports: For wall materials, indicating compliance with requirements for low-emitting materials.

C. Shop Drawings:

1. Include plans, elevations, sections, and attachment details.

D. Samples: Full size crown by one-half soffit width including corner sample of FRP material.

E. Delegated Design Submittal: For FRP panels and suspension system.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: 10 years’ experience manufacturing and supplying fiber-reinforced plastic paneling for projects of similar scope and complexity.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Handle and transport FRP parts to avoid damage. Place non-staining resilient spacers between parts and support parts during shipment.

B. Keep parts clean and dry and stored to prevent distortion, warping, and other physical damage in accordance with the manufacturer's recommendations.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design cold-formed steel framing.

B. Structural Performance: Provide fiber-reinforced plastic panels and suspension system capable of withstanding design loads within limits and under conditions indicated.

1. Wind Loads: Positive and negative pressure as indicated on Drawings.
2. Deflection Limits: For wind loads, no greater than 1/240 of the span.

2.2 MOLDED PLASTIC FABRICATIONS

A. Fiber-Reinforced Plastic Fabrications: Paint-ready, gelcoat-finished, fiber-reinforced plastic panels.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Armstrong Ceiling & Wall Solutions.
b. Formglas Products Ltd.
c. Plasterform Inc.; Armstrong World Industries.
d. Plastrglas, Incorporated.
e. Stromberg Architectural Products, Inc.

2. Face Finish: Paint-ready, smooth matte white gelcoat with a minimum thickness of 15 to 20 mils.
3. Backup Laminate: Consisting of glass fiber polyester composite with 25 to 30 percent glass fiber content.
4. Surface-Burning Characteristics: As follows when tested by a qualified testing agency according to ASTM E84. Identify products with appropriate markings of applicable testing agency.

a. Flame-Spread Index: 25 or less.
b. Smoke-Developed Index: 450 or less.

5. Shell Thickness: 3/16 inch, nominal.
6. Edge Thickness: 3/4 inch, nominal.

B. Embedments: As standard with fiber-reinforced plastic paneling manufacturer and as required for reinforcement and for anchorage to substrates and framing.

2.3 AUXILIARY MATERIALS

A. Steel Drill Screws: ASTM C1002, unless otherwise indicated.

B. Tie Wire: ASTM A641/A641M, Class 1 zinc coating, soft temper, 0.062-inch-diameter wire, or double strand of 0.048-inch-diameter wire.

C. Flat Hangers: Mild steel, zinc coated or protected with rust-inhibitive paint.

D. Angle Hangers: Angles with legs not less than 7/8 inch wide; formed with 0.04-inch-thick, galvanized-steel sheet complying with ASTM A653/A653M, G90 coating designation; with bolted connections and 5/16-inch-diameter bolts.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with ASTM C1467/C1467M.

B. Install fiber-reinforced-plastic fabrications level, plumb, true, and aligned with adjacent materials. Use concealed shims where required for alignment.

C. Attach fiber-reinforced-plastic fabrications to framing and substrates with steel drill screws unless otherwise indicated. Do not use pneumatic staple guns. Countersink screw heads below adjoining finished surface.

1. Predrill fastener holes in units. Clean fastener holes to remove dirt and oil.
2. Locate fasteners not less than 5/16 inch from edges or ends of units.

D. Suspension and Framing Systems: Attach fiber-reinforced-plastic fabrications to structure with tie wires, cold-formed metal framing, flat hangers, or angle hangers at each attachment point indicated on approved Shop Drawings to comply with Performance Requirements.

E. Where fiber-reinforced-plastic fabrications are joined to form composite units, join fabrications with adhesive. Band or brace units together until adhesive cures.

F. Install control joints between fiber-reinforced-plastic fabrications where indicated.

G. Use joint-treatment materials to finish fiber-reinforced-plastic fabrications to produce surfaces ready to receive primers and paint finishes specified in Section 09 91 23 "Interior Painting."

1. Finish fiber-reinforced-plastic fabrications according to ASTM C840 for Level 5 and to match surface texture of units.
2. Repair hollows, voids, scratches, and other surface imperfections on units.

3.3 CLEANING AND PROTECTION

A. Perform cleaning procedures according to FRP manufacturer's written instructions. Take precautions to prevent damage to FRP surfaces and staining of adjacent materials

END OF SECTION

SECTION 07 05 43.13 - RAINSCREEN CLADDING SUPPORT SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes thermally-broken, rainscreen cladding support framing members.

B. Related Requirements:

1. Section 05 40 00 "Cold-Formed Metal Framing" for exterior non-load-bearing wall studs.
2. Section 07 21 00 “Thermal Insulation” for polyisocyanurate insulation installed with and with grooved edge profile to match composite cladding members.
3. Section 07 42 13.13 “Formed Metal Wall Panels” for exterior cladding system.

1.2 ACTION SUBMITTALS

A. Product Data: For rainscreen cladding support system, including all accessories for a complete installation.

B. Shop Drawings:

1. Include layout and spacings of rainscreen cladding support framing; fabrication; and fastening and anchorage details, including mechanical fasteners.
2. Shop drawings to be signed and sealed by a qualified professional engineer, licensed in the State of Maryland and responsible for the delegated design calculations.

C. Delegated-Design Submittal: For rainscreen cladding support systems.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer, for installer and for professional engineer's experience with providing delegated-design engineering services of the kind indicated, including documentation that engineer is licensed in the State of Maryland.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: A company specializing in manufacturing products similar to those specified in this section with at least three years of documented experience.

B. Installer Qualifications:

1. A company specializing in performing the work of this Section with a minimum of 5 years’ experience installing comparable systems; trained and approved by the manufacturer.
2. Installer of the cladding system that the support system specified herein is supporting.

1.5 DELIVERY, STORAGE AND HANDLING

A. Deliver materials to site in manufacturer's original unopened containers and packaging with labels clearly identifying product name and manufacturer.

B. Store materials in clean, dry, and level interior areas or outdoor areas for limited duration in accordance with manufacturer's written instructions.

C. Protect components and auxiliary accessories during transportation, handling, and installation from moisture, excessive temperatures and other construction operations in accordance with manufacturer's written instructions.

D. Handle components in strict compliance with manufacturer's written instructions and recommendations, and in a manner to prevent bending, warping, twisting, and surface, edge or corner damage.

1.6 COORDINATION

A. Coordinate construction of rainscreen cladding support system over substrate indicated for proper drainage, flashing, trim, back-up support, soffits, and other related Work.

1.7 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace rainscreen cladding support system that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Five years from substantial completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, licensed in the State of Maryland, as defined in Section 01 40 00 "Quality Requirements," to design rainscreen cladding support system.

B. Structural Loads:

1. Wind Loads: As indicated on Drawings.

2.2 COMPOSITE FRAMING SUPPORT SYSTEM

A. Composite Framing Support System: System consisting of polyester and vinyl ester bioresin matrix (FRP) with recycled materials, fire retardant additives and integral continuous metal inserts the length of profile. Reinforce system with glass strand rovings used internally for longitudinal (lengthwise) strength and continuous strand glass mats or stitched reinforcements used internally for transverse (crosswise) strength.

1. Basis-of-Design Product: Subject to compliance with requirements, provide **Advanced Architecture Products (A2P); SMARTci GreenGirt** or comparable product.
2. Depth: As indicated on Drawings.
3. Spacing: As required to comply with performance requirements and coordinate with required spacing for formed metal wall panel system specified in Section 07 42 13.13 and metal composite material wall panel system specified in Section 07 42 13.23.
4. Surface Burning Characteristics:

    a. Flame Spread Index: 25 or less, when tested in accordance with ASTM E84.
    b. Smoke Developed Index: 450 or less, when tested in accordance with ASTM E84.

5. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.
6. Provide system with continuous non-corrosive steel insert for engagement of fasteners, at least 16 gauge thick with G90 galvanized coating designation in compliance with ASTM A653/A653M.
7. Insulation: Mineral fiber board insulation as specified in Section 07 21 00 with factory formed edges that interlock with composite framing system components.

B. Alternative Framing Support System: Alternative thermally broken cladding support systems that do not require any change in system depth and are fabricated of differing composition to that specified above by the following will be considered as comparable products:

1. Armatherm.
2. Knight Wall Systems.
3. SFS Group USA, Inc.

2.3 ACCESSORIES

A. Provide accessories necessary for complete rainscreen cladding support system including metal closure trim, transition angles, strapping tie-in brackets, and similar items.

B. Fasteners: Corrosion-resistant, self-tapping and self-drilling screws, bolts, nuts, and other fasteners as recommended by rainscreen cladding support system manufacturer for project application.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, substrates, and other conditions affecting performance of the Work.

1. Examine structural wall framing to ensure that angles, channels, studs, and other structural support members have been installed within alignment tolerances required by rainscreen cladding support system manufacturer
2. Examine wall sheathing to verify that sheathing joints are supported by framing or blocking, and that installation is within flatness tolerances required by rainscreen cladding support system and metal wall panel manufacturer.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean surfaces thoroughly prior to installation.

B. Prepare sub-framing, base angles, sills, furring, and other rainscreen cladding support system members and provide anchorage in accordance with ASTM C754 for substrate type and wall cladding type in accordance with manufacturer’s installation instructions.

3.3 COMPOSITE FRAMING SUPPORT SYSTEM INSTALLATION

A. Install rainscreen cladding support system in accordance with manufacturer's installation instructions.

B. Install system to fill-in exterior spaces without gaps or voids, and do not compress insulation panels.

C. Trim insulation neatly to fit spaces, and insulate miscellaneous gaps and voids.

3.4 ERECTION TOLERANCES

A. Shim and align rainscreen cladding support system within installed tolerances of 1/4 inch in 20 feet, non-cumulative, level, plumb, and on location lines as indicated

END OF SECTION

SECTION 07 11 13 - BITUMINOUS DAMPPROOFING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Cold-applied, emulsified-asphalt dampproofing.

B. Related Requirements:

1. Section 33 46 00 "Subdrainage" for perforated-wall pipe and fittings, drainage conduits, and geotextile filter fabrics used to construct perimeter foundation drain.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.3 FIELD CONDITIONS

A. Weather Limitations: Proceed with application only when existing and forecasted weather conditions permit dampproofing to be performed according to manufacturers' written instructions.

B. Ventilation: Provide adequate ventilation during application of dampproofing in enclosed spaces. Maintain ventilation until dampproofing has cured.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Source Limitations: Obtain primary dampproofing materials and primers from single source from single manufacturer. Provide protection course, drainage panels and auxiliary materials recommended in writing by manufacturer of primary materials.

2.2 PERFORMANCE REQUIREMENTS

A. VOC Content: Products shall comply with VOC content limits of authorities having jurisdiction unless otherwise indicated.

2.3 COLD-APPLIED, EMULSIFIED-ASPHALT DAMPPROOFING

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. BASF Corporation; Construction Systems.
2. ChemMasters, Inc.
3. Euclid Chemical Company (The); an RPM company.
4. Henry Company.
5. Karnak Corporation.
6. W. R. Meadows, Inc.

B. Trowel Coats: ASTM D 1227, Type II, Class 1.

C. Fibered Brush and Spray Coats: ASTM D 1227, Type II, Class 1.

D. Brush and Spray Coats: ASTM D 1227, Type III, Class 1.

2.4 AUXILIARY MATERIALS

A. Furnish auxiliary materials recommended in writing by dampproofing manufacturer for intended use and compatible with bituminous dampproofing.

B. Emulsified-Asphalt Primer: ASTM D 1227, Type III, Class 1, except diluted with water as recommended in writing by manufacturer.

C. Asphalt-Coated Glass Fabric: ASTM D 1668/D 1668M, Type I.

D. Patching Compound: Asbestos-free fibered mastic of type recommended in writing by dampproofing manufacturer.

E. Protection Course: ASTM D 6506, semirigid sheets of fiberglass or mineral-reinforced-asphaltic core, pressure laminated between two asphalt-saturated fibrous liners.

1. Thickness: Nominal 1/8 inch.
2. Adhesive: Rubber-based solvent type recommended in writing by waterproofing manufacturer for protection course type.

2.5 MOLDED-SHEET DRAINAGE PANELS

A. Nonwoven-Geotextile-Faced, Molded-Sheet Drainage Panel: Composite subsurface drainage panel acceptable to dampproofing manufacturer and consisting of a studded, nonbiodegradable, molded-plastic-sheet drainage core; with a nonwoven, needle-punched geotextile facing with an apparent opening size not exceeding No. 70 sieve laminated to one side of the core, with or without a polymeric film bonded to the other side; and with a vertical flow rate through the core of 9 to 21 gpm per ft..

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. American Hydrotech, Inc.
b. Carlisle Coatings & Waterproofing Inc.
c. CETCO.
d. GCP Applied Technologies Inc.
e. ISI Building Products.
f. Master Builders Solutions.
g. Polyguard Products, Inc.
h. Urethane Polymers International, Inc.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Applicator present, for compliance with requirements for surface smoothness, maximum surface moisture content, and other conditions affecting performance of the Work.

B. Proceed with application only after substrate construction and penetrating work have been completed and unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean, prepare, and treat substrates according to manufacturer's written instructions. Provide clean, dust-free, and dry substrates for dampproofing application.

B. Mask or otherwise protect adjoining exposed surfaces from being stained, spotted, or coated with dampproofing. Prevent dampproofing materials from entering and clogging weep holes and drains.

C. Clean substrates of projections and substances detrimental to dampproofing work; fill voids, seal joints, and remove bond breakers if any.

D. Apply patching compound to patch and fill tie holes, honeycombs, reveals, and other imperfections.

3.3 APPLICATION, GENERAL

A. Comply with manufacturer's written instructions for dampproofing application, cure time between coats, and drying time before backfilling unless otherwise indicated.

1. Apply dampproofing to provide continuous plane of protection.
2. Apply additional coats if recommended in writing by manufacturer or to achieve a smooth surface and uninterrupted coverage.

B. Where dampproofing footings and foundation walls, apply from finished-grade line to top of footing; extend over top of footing and down a minimum of 6 inches over outside face of footing.

1. Extend dampproofing 12 inches onto intersecting walls and footings, but do not extend onto surfaces exposed to view when Project is completed.

2. Install flashings and corner protection stripping at internal and external corners, changes in plane, construction joints, cracks, and where indicated as "reinforced," by embedding an 8-inch-wide strip of asphalt-coated glass fabric in a heavy coat of dampproofing. Dampproofing coat for embedding fabric is in addition to other coats required.

3.4 PROTECTION COURSE INSTALLATION

A. Install protection course over completed-and-cured dampproofing. Comply with dampproofing-material and protection-course manufacturers' written instructions for attaching protection course.

1. Support protection course over cured coating with spot application of adhesive type recommended in writing by protection-board manufacturer.
2. Install protection course within 24 hours of dampproofing installation (while coating is tacky) to ensure adhesion.

3.5 INSTALLATION OF DRAINAGE PANEL

A. Molded-Sheet Drainage Panels: Install panels, with geotextile facing away from wall substrate, according to manufacturer's written instructions. Use adhesive or another method that does not penetrate dampproofing. Lap edges and ends of geotextile to maintain continuity. Protect installed molded-sheet drainage panels during subsequent construction.

3.6 PROTECTION

A. Protect installed insulation drainage panels from damage due to UV light, harmful weather exposures, physical abuse, and other causes. Provide temporary coverings where panels are subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

B. Correct dampproofing that does not comply with requirements; repair substrates, and reapply dampproofing.

END OF SECTION

SECTION 07 13 26 - SELF-ADHERING SHEET WATERPROOFING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Sheet waterproofing.
2. Molded-sheet drainage panels.

B. Related Requirements:

1. Section 33 46 00 "Subdrainage" for perforated-wall pipe and fittings, drainage conduits, and geotextile filter fabrics used to construct perimeter foundation drain.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review waterproofing requirements including surface preparation, substrate condition and pretreatment, minimum curing period, forecasted weather conditions, special details and sheet flashings, installation procedures, testing and inspection procedures, and protection and repairs.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, and tested physical and performance properties of waterproofing.
2. Include manufacturer's written instructions for evaluating, preparing, and treating substrate.

B. Sustainable Design Submittals:

C. Shop Drawings: Show locations and extent of waterproofing and details of substrate joints and cracks, expansion joints, sheet flashings, penetrations, inside and outside corners, tie-ins with adjoining waterproofing, and other termination conditions.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Field quality-control reports.

C. Sample Warranties: For special warranties.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by waterproofing manufacturer.

B. Mockups: Build mockups to verify selections made under Sample submittals and to set quality standards for installation.

1. Build for each typical waterproofing installation including accessories to demonstrate surface preparation, crack and joint treatments, inside and outside corner treatments, and protection.

a. Size: 100 sq. ft. in area minimum.
b. Description: Each type of wall installation.

2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.6 FIELD CONDITIONS

A. Environmental Limitations: Apply waterproofing within the range of ambient and substrate temperatures recommended in writing by waterproofing manufacturer. Do not apply waterproofing to a damp or wet substrate.

1. Do not apply waterproofing in snow, rain, fog, or mist.

B. Maintain adequate ventilation during preparation and application of waterproofing materials.

1.7 WARRANTY

A. Manufacturer's Warranty:

1. Waterproofing Warranty: Manufacturer agrees to furnish replacement waterproofing material for waterproofing that does not comply with requirements or that fails to remain watertight within specified warranty period.

a. Warranty Period: Five years from date of Substantial Completion.

B. Installer's Special Warranty: Signed by Installer, covering Work of this Section, for warranty period of two years.

1. Warranty includes removing and reinstalling earth backfill, protection board, drainage panels, and insulation.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Source Limitations for Waterproofing System: Obtain waterproofing materials, protection course, and molded-sheet drainage panels from single source from single manufacturer or from manufacturers approved in writing by waterproofing membrane manufacturer.

2.2 SHEET WATERPROOFING

A. Modified Bituminous Sheet Waterproofing: Minimum 60-mil nominal thickness, self-adhering sheet consisting of 56 mils of rubberized asphalt laminated on one side to a 4-mil-thick, polyethylene-film reinforcement, and with release liner on adhesive side; formulated for application with primer or surface conditioner that complies with VOC limits of authorities having jurisdiction.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. CETCO is a subsidiary of Minerals Technologies Inc.
    b. Carlisle Coatings & Waterproofing Inc.
    c. GCP Applied Technologies Inc.
    d. Henry Company.
    e. W. R. Meadows, Inc.

2. Physical Properties:

    a. Tensile Strength, Membrane: 250 psi minimum; ASTM D412, Die C, modified.
    b. Ultimate Elongation: 300 percent minimum; ASTM D412, Die C, modified.
    c. Low-Temperature Flexibility: Pass at minus 20 deg F; ASTM D1970/D1970M.
    d. Crack Cycling: Unaffected after 100 cycles of 1/8-inch movement; ASTM C836/C836M.
    e. Puncture Resistance: 40 lbf minimum; ASTM E154/E154M.
    f. Water Absorption: 0.2 percent weight-gain maximum after 48-hour immersion at 70 deg F; ASTM D570.
    g. Water Vapor Permeance: 0.05 perm maximum; ASTM E96/E96M, Water Method.
    h. Hydrostatic-Head Resistance: 200 feet minimum; ASTM D5385.

3. Sheet Strips: Self-adhering, rubberized-asphalt strips of same material and thickness as sheet waterproofing.

2.3 ACCESSORIES

A. Furnish accessory materials recommended by waterproofing manufacturer for intended use and compatible with sheet waterproofing.

1. Furnish liquid-type accessory materials that comply with VOC limits of authorities having jurisdiction.

B. Primer: Liquid primer recommended for substrate by sheet waterproofing material manufacturer.

C. Surface Conditioner: Liquid, waterborne surface conditioner recommended for substrate by sheet waterproofing material manufacturer.

D. Liquid Membrane: Elastomeric, two-component liquid, cold fluid applied, of trowel grade or low viscosity.

E. Substrate Patching Membrane: Low-viscosity, two-component, modified asphalt coating.

F. Metal Termination Bars: Aluminum bars, approximately 1 by 1/8 inch, predrilled at 9-inch centers.

2.4 MOLDED-SHEET DRAINAGE PANELS

A. Nonwoven-Geotextile-Faced, Molded-Sheet Drainage Panel with Polymeric Film: Composite subsurface drainage panel acceptable to waterproofing manufacturer and consisting of a studded, nonbiodegradable, molded-plastic-sheet drainage core; with a nonwoven, needle-punched geotextile facing with an apparent opening size not exceeding No. 70 sieve laminated to one side of the core and a polymeric film bonded to the other side; and with a vertical flow rate through the core of 9 to 21 gpm per ft..

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. American Hydrotech, Inc.
    b. CETCO is a subsidiary of Minerals Technologies Inc.
    c. Carlisle Coatings & Waterproofing Inc.
    d. GCP Applied Technologies Inc.
    e. Henry Company.
    f. ISI Building Products.
    g. Master Builders Solutions.
    h. Polyguard Products, Inc.
    i. Urethane Polymers International, Inc. (UPI).

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of waterproofing.

1. Verify that concrete has cured and aged for minimum time period recommended in writing by waterproofing manufacturer.
2. Verify that substrate is visibly dry and within the moisture limits recommended in writing by manufacturer. Test for capillary moisture by plastic sheet method in accordance with ASTM D4263.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean, prepare, and treat substrates according to manufacturer's written instructions. Provide clean, dust-free, and dry substrates for waterproofing application.

B. Mask off adjoining surfaces not receiving waterproofing to prevent spillage and overspray affecting other construction.

C. Remove grease, oil, bitumen, form-release agents, paints, curing compounds, and other penetrating contaminants or film-forming coatings from concrete.

D. Remove fins, ridges, mortar, and other projections.

E. Fill form tie holes, honeycomb, aggregate pockets, holes, and other voids.

F. Prepare, fill, prime, and treat joints and cracks in substrates. Remove dust and dirt from joints and cracks in accordance with ASTM D4258.

1. Install sheet strips of width according to manufacturer's written instructions and center over treated construction and contraction joints and cracks exceeding a width of 1/16 inch.

G. Bridge and cover isolation joints, expansion joints, and discontinuous deck-to-wall joints with overlapping sheet strips of widths according to manufacturer's written instructions.

1. Invert and loosely lay first sheet strip over center of joint. Firmly adhere second sheet strip to first and overlap to substrate.

H. Corners: Prepare, prime, and treat inside and outside corners in accordance with manufacturer's instructions.

1. Install membrane strips centered over vertical inside corners. Install 3/4-inch fillets of liquid membrane on horizontal inside corners and as follows:

a. At footing-to-wall intersections, extend liquid membrane in each direction from corner or install membrane strip centered over corner.

I. Prepare, treat, and seal vertical and horizontal surfaces at terminations and penetrations through waterproofing and at drains and protrusions.

3.3 INSTALLATION OF SHEET WATERPROOFING

A. Install modified bituminous sheets according to waterproofing manufacturer's written instructions.

B. Apply primer to substrates at required rate and allow it to dry. Limit priming to areas that will be covered by sheet waterproofing in same day. Reprime areas exposed for more than 24 hours.

C. Apply and firmly adhere sheets over area to receive waterproofing. Accurately align sheets and maintain uniform 2-1/2-inch-minimum lap widths and end laps. Overlap and seal seams, and stagger end laps to ensure watertight installation.

1. When ambient and substrate temperatures range between 25 and 40 deg F, install self-adhering, modified bituminous sheets produced for low-temperature application. Do not use low-temperature sheets if ambient or substrate temperature is higher than 60 deg F.

D. Apply continuous sheets over already-installed sheet strips, bridging substrate cracks, construction, and contraction joints.

E. Seal edges of sheet waterproofing terminations with termination bar and mastic.

F. Install sheet waterproofing and accessory materials to tie into adjacent waterproofing.

G. Roll waterproofing membrane to firmly adhere to substrate. Roll seams and terminations.

H. Repair tears, voids, and lapped seams in waterproofing not complying with requirements. Slit and flatten fishmouths and blisters. Patch with sheet waterproofing extending 6 inches beyond repaired areas in all directions.

I. Immediately install protection course with butted joints over waterproofing membrane.

1. Molded-sheet drainage panels may be used in place of a separate protection course to vertical applications when approved by waterproofing manufacturer and installed immediately.

3.4 INSTALLATION OF MOLDED-SHEET DRAINAGE PANELS

A. Place and secure molded-sheet drainage panels, with geotextile facing away from wall or deck substrate, according to manufacturer's written instructions. Use adhesive or another method that does not penetrate waterproofing. Lap edges and ends of geotextile to maintain continuity. Protect installed molded-sheet drainage panels during subsequent construction.

3.5 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a site representative qualified by waterproofing membrane manufacturer to inspect substrate conditions, surface preparation, membrane application, flashings, protection, and drainage components; and to furnish daily reports to Architect.

B. Waterproofing will be considered defective if it does not pass tests and inspections.

3.6 PROTECTION, REPAIR, AND CLEANING

A. Protect waterproofing from damage and wear during remainder of construction period.

B. Correct deficiencies in or remove waterproofing that does not comply with requirements; repair substrates, reapply waterproofing, and repair sheet flashings.

C. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended in writing by manufacturer of affected construction.

END OF SECTION

This page is intentionally left blank.

SECTION 07 14 13 - HOT FLUID-APPLIED RUBBERIZED ASPHALT WATERPROOFING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Hot fluid-applied, rubberized-asphalt waterproofing membrane.
2. Insulation.
3. Plaza-deck pavers.

B. Related Requirements:

1. Section 07 72 73 "Vegetated Roof Systems" for vegetated roof assembly installed over hot fluid-applied rubberized asphalt waterproofing and insulation including plaza-deck pavers whether associated in conjunction with vegetated roof system or not.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review waterproofing requirements, including surface preparation, substrate condition and pretreatment, minimum curing period, forecasted weather conditions, special details and sheet flashings, installation procedures, testing and inspection procedures, installation of vegetated roof systems and plaza-deck pavers, and protection and repairs.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product. Include manufacturer's written instructions for evaluating, preparing, and treating substrate, technical data, and tested physical and performance properties of waterproofing.

B. Shop Drawings: Show locations and extent of waterproofing. Include details for substrate joints and cracks, sheet flashings, penetrations, inside and outside corners, tie-ins to adjoining waterproofing, and other termination conditions. Where installed under vegetated roof systems and pedestal-supported concrete pavers submit jointly with shop drawings required in Section 07 72 73 “Vegetated Roof Systems.”

C. Samples: For plaza-deck pavers, full sized in each color and texture required.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Field quality-control reports.

C. Sample Warranties: For special warranties.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

B. Mockups: Install waterproofing to 100 sq. ft. of deck to demonstrate surface preparation, crack and joint treatment, corner treatment, thickness, texture, and execution quality. Install pavers and paver supports to demonstrate aesthetic effects, and set quality standards for materials and execution

1. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by waterproofing manufacturer.

B. Remove and replace liquid materials that cannot be applied within their stated shelf life.

C. Protect stored materials from direct sunlight.

1.7 FIELD CONDITIONS

A. Weather Limitations: Apply waterproofing within the range of ambient and substrate temperatures recommended by waterproofing manufacturer. Do not apply waterproofing to a damp or wet substrate, or when temperature is below zero deg F.

1. Do not apply waterproofing in snow, rain, fog, or mist.

B. Maintain adequate ventilation during application and curing of waterproofing materials.

1.8 WARRANTY

A. Special Warranty: Single source warranty for hot fluid-applied rubberized asphalt waterproofing and vegetated roof system wherein manufacturer agrees to repair or replace waterproofing and sheet flashings that do not comply with requirements or that fail to remain watertight within specified warranty period.

1. Warranty includes removing and reinstalling protection board, drainage panels, insulation, vegetated roof components, pedestals, and pedestal-mounted pavers on plaza decks.
2. Warranty insulation retains 80 percent of original published thermal value.

3. Warranty pavers do not dish or warp and do not crack, split, or disintegrate in freeze-thaw conditions.
4. Warranty Period: 10 years from date of Substantial Completion.

B. Special Installer's Warranty: Specified form signed by Installer, covering Work of this Section, for warranty period of two years.

1. Warranty includes removing and reinstalling protection board, drainage panels, insulation, vegetated roof components, pedestals, and pedestal-mounted pavers on plaza decks.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Source Limitations: Obtain waterproofing materials sheet flashings protection course molded-sheet drainage panels, insulation, pavers and pedestals from single source from single manufacturer.

2.2 WATERPROOFING MEMBRANE

A. Hot Fluid-Applied, Rubberized-Asphalt Waterproofing Membrane: Single component; 100 percent solids; hot fluid-applied, rubberized asphalt.

1. Basis-of-Design Product: Subject to compliance with requirements, provide **American Hydrotech, Inc.; MM6125** or a comparable product by one of the following:

a. Carlisle Coatings & Waterproofing Inc.
b. Henry Company.

2.3 ACCESSORIES

A. General: Accessory materials recommended by waterproofing manufacturer for intended use and compatible with waterproofing.

B. Primer: ASTM D41/D41M, asphaltic primer.

C. Elastomeric Sheet: 50-mil-minimum, uncured sheet neoprene as follows:

1. Tensile Strength: 1400 psi minimum; ASTM D412, Die C.
2. Elongation: 300 percent minimum; ASTM D412.
3. Tear Resistance: 125 psi minimum; ASTM D624, Die C.
4. Brittleness: Does not break at minus 30 deg F; ASTM D2137.

D. Metal Termination Bars: Manufacturer's standard, predrilled stainless steel or aluminum termination bars; approximately 1 by 1/8 inch thick; with stainless steel anchors.

E. Sealants and Accessories: Manufacturer's recommended sealants and accessories.

F. Reinforcing Fabric: Manufacturer's recommended, spun-bonded polyester fabric.

G. Rubberized Sheet Protection Course: Manufacturer's standard, 80- to 90-mil-thick, fiberglass-reinforced rubberized asphalt or modified bituminous sheet.

2.4 INSULATION

A. Unfaced Plaza-Deck Insulation Drainage Panels: Extruded-polystyrene board insulation complying with ASTM C578, Type VI, 40 psi minimum compressive resistance; unfaced; fabricated with shiplapped or channel edges and with one side having ribbed drainage channels.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. DiversiFoam Products.
b. Owens Corning.
c. The Dow Chemical Company.

2.5 PLAZA-DECK PAVERS

A. Concrete Plaza-Deck Pavers: Heavyweight, hydraulically pressed, concrete units, square edged, manufactured for use as plaza-deck pavers; minimum compressive strength 7500 psi, ASTM C140; absorption not greater than 5 percent, ASTM C140; no breakage and maximum 1 percent mass loss when tested for freeze-thaw resistance in accordance with ASTM C67.

1. Basis-of-Design Product: Subject to compliance with requirement, provide **Hanover Architectural Products; Roof & Plaza Pavers** or comparable product by one of the following:

a. Holcim, Elevate.
b. Tile Tech Pavers.
c. Wausau Tile.
d. Westile Roofing Products.

2. Thickness: 2 inches.
3. Face Size: 24 inches square.
4. Color: Hanover, “Natural” with “Tudor Finish.”

B. Paver Supports: Paver manufacturer's standard SBR rubber, high-density polyethylene, or polyurethane paver support assembly, including adjustable or stackable pedestals, shims, and spacer tabs for joint spacing of 1/8 to 3/16 inch.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

1. Verify that concrete has cured and aged for minimum time period recommended by waterproofing manufacturer.
2. Verify that substrate is visibly dry and free of moisture. Test for capillary moisture by plastic sheet method in accordance with ASTM D4263.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean and prepare substrates according to manufacturer's written instructions. Provide clean, dust-free, and dry substrate for waterproofing application.

B. Mask off adjoining surfaces not receiving waterproofing to prevent spillage and overspray affecting other construction.

C. Close off deck drains and other deck penetrations to prevent spillage and migration of waterproofing fluids.

D. Remove grease, oil, form-release agents, paints, curing compounds, and other penetrating contaminants or film-forming coatings from concrete.

E. Remove fins, ridges, and other projections, and fill honeycomb, aggregate pockets, and other voids.

3.3 JOINTS, CRACKS, AND TERMINATIONS

A. Prepare and treat substrates to receive waterproofing membrane, including joints and cracks, deck drains, corners, and penetrations according to manufacturer's written instructions.

1. Rout and fill joints and cracks in substrate. Before filling, remove dust and dirt in accordance with ASTM D4258.
2. Adhere strip of elastomeric sheet to substrate in a layer of hot rubberized asphalt. Extend elastomeric sheet a minimum of 6 inches on each side of moving joints and cracks or joints and cracks exceeding 1/8 inch thick, and beyond deck drains and penetrations. Apply second layer of hot fluid-applied, rubberized asphalt over elastomeric sheet.
3. Embed strip of reinforcing fabric into a layer of hot rubberized asphalt. Extend reinforcing fabric a minimum of 6 inches on each side of nonmoving joints and cracks not exceeding 1/8 inch thick, and beyond roof drains and penetrations.

B. At expansion joints and discontinuous deck-to-wall or deck-to-deck joints, bridge joints with elastomeric sheet extended a minimum of 6 inches on each side of joints and adhere to substrates in a layer of hot rubberized asphalt. Apply second layer of hot fluid-applied, rubberized asphalt over elastomeric sheet.

3.4 INSTALLATION OF FLASHING

A. Install elastomeric sheets at terminations of waterproofing membrane according to manufacturer's written instructions.

B. Prime substrate with asphalt primer.

C. Install elastomeric sheet and adhere to deck and wall substrates in a layer of hot rubberized asphalt.

D. Extend elastomeric sheet up walls or parapets a minimum of 8 inches above plaza-deck pavers and 6 inches onto deck to be waterproofed.

E. Install termination bars and mechanically fasten to top of elastomeric flashing sheet at terminations and perimeter of waterproofing.

3.5 INSTALLATION OF HOT FLUID-APPLIED, RUBBERIZED ASPHALT WATERPROOFING MEMBRANE

A. Apply primer, at manufacturer's recommended rate, over prepared substrate and allow it to dry.

B. Heat and apply rubberized asphalt according to manufacturer's written instructions.

1. Heat rubberized asphalt in an oil- or air-jacketed melter with mechanical agitator specifically designed for heating rubberized asphalt.

C. Start application with manufacturer's authorized representative present.

D. Reinforced Membrane: Apply hot rubberized asphalt to substrates and adjoining surfaces indicated. Spread to a thickness of 90 mils; embed reinforcing fabric, overlapping sheets 2 inches; spread another 125-mil-thick layer to provide a uniform, reinforced, seamless membrane 215 mils thick.

E. Apply waterproofing over prepared joints and up wall terminations and vertical surfaces to heights indicated or required by manufacturer.

F. Cover waterproofing with protection course with overlapped joints before membrane is subject to construction traffic.

3.6 INSTALLATION OF INSULATION

A. Install one or more layers of board insulation to achieve required thickness over waterproofed surfaces. Cut and fit to within 3/4 inch of projections and penetrations.

B. On horizontal surfaces, loosely lay insulation units according to manufacturer's written instructions. Stagger end joints and tightly abut insulation units.

3.7 INSTALLATION OF PLAZA-DECK PAVERS

A. Install concrete pavers according to manufacturer's written instructions.

B. Accurately install adjustable-height paver pedestals and accessories to elevations required. Adjust for final level and slope with shims.

C. Loosely lay pavers on pedestals, maintaining a uniform open joint width. Tightly seat pavers against spacers to eliminate lateral movement or drift of paving assembly. Align joint patterns parallel in each direction.

1. Lay out pavers to avoid less-than-half-width pavers at perimeter or other terminations.

D. Install pavers to not vary more than 1/16 inch in elevation between adjacent pavers or more than 1/16 inch from surface plane elevation of individual paver.

E. Limit variation in paving installation to within 1/4 inch in 10 feet of surface plane in any direction; noncumulative.

3.8 FIELD QUALITY CONTROL

A. Engage a full-time site representative qualified by waterproofing membrane manufacturer to inspect substrate conditions; surface preparation; and application of membrane, flashings, protection, and drainage components; furnish daily reports to Architect.

1. Site representative is to measure membrane thickness with pin tester or other suitable device at least once for every 100 sq. ft. and include measurements in reports.

B. Testing Agency: Owner will engage a qualified testing agency to inspect substrate conditions, surface preparation, waterproofing application, protection, and drainage components, and to furnish reports to Architect.

1. Electric Leak Detection (ELD): Testing agency is to survey entire waterproofing area for potential leaks using ELD.

3.9 CLEANING AND PROTECTION

A. Protect waterproofing from damage and wear during remainder of construction period.

B. Protect installed board insulation from damage due to UV light, harmful weather exposures, physical abuse, and other causes. Provide temporary coverings where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

C. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION

This page is intentionally left blank.

SECTION 07 16 16 - CRYSTALLINE WATERPROOFING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Crystalline waterproofing.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, and installation instructions.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Applicator.

B. Product Certificates: For each type of waterproofing, patching, and plugging material.

C. Product Test Reports: For each product formulation, for tests performed by manufacturer and witnessed by a qualified testing agency.

D. Field quality-control reports.

1.4 QUALITY ASSURANCE

A. Applicator Qualifications: A firm experienced in applying crystalline waterproofing similar in material, design, and extent to that indicated for this Project, whose work has resulted in applications with a record of successful in-service performance, and that employs workers trained and approved by manufacturer.

1.5 FIELD CONDITIONS

A. Weather Limitations: Proceed with application only when existing and forecasted weather conditions permit crystalline waterproofing to be performed according to manufacturer's written instructions.

B. Proceed with waterproofing work only after pipe sleeves, vents, curbs, inserts, drains, and other projections through the substrate to be waterproofed have been completed. Proceed only after substrate defects, including honeycombs, voids, and cracks, have been repaired to provide a sound substrate free of forming materials, including reveal inserts.

C. Ambient Conditions: Proceed with waterproofing work only if temperature is maintained at 40 deg F or above during work and cure period, and space is well ventilated and kept free of water.

PART 2 - PRODUCTS

2.1 WATERPROOFING MATERIALS

A. Crystalline Waterproofing: Prepackaged, gray-colored proprietary blend of portland cement, specially treated sand, and active chemicals that, when mixed with water and applied, penetrates into concrete and concrete unit masonry and reacts chemically with the byproducts of cement hydration in the presence of water to develop crystalline growth within substrate capillaries to produce an impervious, dense, waterproof substrate; with properties complying with or exceeding the criteria specified below.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. AQUAFIN, Inc.
    b. Euclid Chemical Company (The); an RPM company.
    c. KOSTER American Corporation.
    d. Kryton International, Inc.
    e. Penetron International, Ltd.
    f. Xypex Chemical Corporation.

2. Water Permeability: Maximum zero for water at 30 feet when tested in accordance with COE CRD-C 48.
3. Compressive Strength: Minimum 4000 psi at 28 days when tested in accordance with ASTM C109/C109M.

2.2 ACCESSORY MATERIALS

A. Patching Compound: Factory-premixed cementitious repair mortar, crack filler, or sealant recommended by waterproofing manufacturer for filling and patching tie holes, honeycombs, reveals, and other imperfections; and compatible with substrate and other materials indicated.

B. Plugging Compound: Factory-premixed cementitious compound with hydrophobic properties and recommended by waterproofing manufacturer; resistant to water and moisture but vapor permeable for all standard applications (vertical, overhead, and horizontal surfaces not exposed to vehicular traffic); and compatible with substrate and other materials indicated.

C. Water: Potable.

2.3 MIXES

A. Crystalline Waterproofing: Add prepackaged dry ingredients to water according to manufacturer's written instructions. Mix together with mechanical mixer or by hand to required consistency.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Applicator present, for suitable conditions where waterproofing is to be applied.

B. Proceed with application only after unsatisfactory conditions have been corrected.

C. Notify Architect in writing of active leaks or defects that would affect system performance.

3.2 PREPARATION

A. Comply with manufacturer's written instructions.

B. Protect other work from damage caused by cleaning, preparation, and application of waterproofing. Provide temporary enclosure to confine spraying operation and to ensure adequate ambient temperatures and ventilation conditions for application.

C. Do not allow waterproofing, patching, and plugging materials to enter reveals or annular spaces intended for resilient sealants or gaskets, such as joint spaces between pipes and pipe sleeves.

D. Stop active water leaks with plugging compound.

E. Repair damaged or unsatisfactory substrate with patching compound.

1. At holes and cracks 1/16 inch wide or larger in substrate, remove loosened chips and cut reveal with sides perpendicular to surface, not tapered, and minimum 1 inch deep. Fill reveal with patching compound flush with surface.

F. Surface Preparation: Remove efflorescence, chalk, dust, dirt, mortar spatter, grease, oils, paint, curing compounds, and form-release agents to ensure that waterproofing bonds to surfaces.

1. Clean concrete surfaces according to ASTM D4258.

    a. Scratch- and Float-Finished Concrete: Etch with 10 percent muriatic acid solution according to ASTM D4260.
    b. Smooth-Formed and Trowel-Finished Concrete: Prepare by mechanical abrading or abrasive-blast cleaning according to ASTM D4259.

2. Concrete Joints: Clean reveals.

3.3 INSTALLATION

A. Comply with waterproofing manufacturer's written instructions for application and curing.

1. Saturate surface with water for several hours and maintain damp condition until applying waterproofing. Remove standing water.

2. Apply waterproofing to surfaces, and extend waterproofing onto adjacent surfaces as follows:

    a. Onto every substrate in areas indicated for treatment, including sumps and similar offsets and features.

3. Number of Coats: Number required for specified water permeability.
4. Application Method: Apply to ensure that each coat fills voids and is in full contact with substrate or previous coat.
5. Dampen surface between coats.

B. Final Coat Finish: Smooth.

C. Curing: Moist-cure waterproofing for three days immediately after final coat has set, followed by air drying, unless otherwise recommended in writing by manufacturer.

3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect completed application of waterproofing.

B. Prepare test and inspection reports.

END OF SECTION

SECTION 07 18 00 - TRAFFIC COATINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Traffic coatings for the following applications:

1. Equipment-room floor.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include installation instructions and details, material descriptions, dry or wet film thickness requirements, and finish.

B. Sustainable Design Submittals:

1. Product Data: For coatings, indicating VOC content.
2. Laboratory Test Reports: For coatings, indicating compliance with requirements for low-emitting materials.

C. Shop Drawings: For traffic coatings.

1. Include details for treating substrate joints and cracks, flashings, deck penetrations, and other termination conditions that are not included in manufacturer's product data.

D. Samples for Initial Selection: For each type of exposed finish.

E. Samples for Verification: For each type of exposed finish, prepared on rigid backing.

1. Provide stepped Samples on backing to illustrate buildup of traffic coatings.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Certificates: For each type of traffic coating.

C. Sample Warranty: For manufacturer's warranty.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For traffic coatings to include in maintenance manuals.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

1.6 FIELD CONDITIONS

A. Environmental Limitations: Apply traffic coatings within the range of ambient and substrate temperatures recommended in writing by manufacturer. Do not apply traffic coatings to damp or wet substrates, when temperatures are below 40 deg F, when relative humidity exceeds 85 percent, or when temperatures are less than 5 deg F above dew point.

1. Do not apply traffic coatings in snow, rain, fog, or mist, or when such weather conditions are imminent during the application and curing period. Apply only when frost-free conditions occur throughout the depth of substrate.

B. Do not install traffic coating until items that penetrate membrane have been installed.

1.7 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace traffic coating that fails in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Adhesive or cohesive failures.
b. Abrasion or tearing failures.
c. Surface crazing or spalling.
d. Intrusion of water, oils, gasoline, grease, salt, deicer chemicals, or acids into deck substrate.

2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Obtain traffic coatings from single source from single manufacturer.

B. Obtain primary traffic-coating materials, including primers, from traffic-coating manufacturer. Obtain accessory materials including aggregates, sheet flashings, joint sealants, and substrate repair materials of types and from sources recommended in writing by primary material manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Material Compatibility: Provide primers; base coat, intermediate coat, and topcoat; and accessory materials that are compatible with one another and with substrate under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.

2.3 TRAFFIC COATINGS

A. Traffic Coating: Manufacturer's standard, traffic-bearing, seamless, high-solids-content, cold liquid-applied, elastomeric, water-resistant membrane system with integral wearing surface for equipment-room floor service condition; according to ASTM C957/C957M.

1. Basis-of-Design Product: Subject to compliance with requirements, provide **Tremco Incorporated; Vulkem 350NF/351NF** or a comparable product by one of the following:

    a. Master Builders Solutions; Masterseal Pedestrian Traffic 2500.
    b. Neogard; Hempel Group; Peda-Gard M.
    c. Pecora Corporation; Pecora-Deck, 801VOC/802FC/HB1000.

B. Primer: Liquid primer as recommended in writing for substrate and conditions by traffic-coating manufacturer.

C. Preparatory and Base Coats: Single-component, urethane.

1. Thicknesses: Minimum 40 mil wet-film thickness or as recommended in writing by manufacturer for substrate and service conditions indicated.

D. Topcoat: Two-component, aliphatic polyurethane.

1. Thicknesses: Minimum 12 mil wet-film thickness or as recommended in writing by manufacturer for substrate and service conditions indicated, measured excluding aggregate.
2. Aggregate Content: As recommended in writing by traffic-coating manufacturer for substrate and service conditions indicated but not less than 4 to 6 lb/gal.
3. Color: As selected by Architect from manufacturer's full range.

E. Aggregate: Manufacturer's standard aggregate for each use indicated of particle sizes, shape, and minimum hardness recommended in writing by traffic-coating manufacturer.

F. VOC Content: 250 g/L or less.

G. Low-Emitting Materials: Verify VOC emissions of interior coatings comply with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers." Verify formaldehyde emissions do not exceed 9 mcg/cu. m or 7 ppb, whichever is less.

2.4 ACCESSORY MATERIALS

A. Joint Sealants: Single-Component, Non-Sagging Urethane Joint Sealant; ASTM C 920, Type NS, Class 50.

B. Sheet Flashing: Nonstaining sheet material recommended in writing by traffic-coating manufacturer.

C. Adhesive: Contact adhesive recommended in writing by traffic-coating manufacturer.

D. Reinforcing Strip: Fiberglass mesh recommended in writing by traffic-coating manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for maximum moisture content, surface smoothness, and other conditions affecting performance of traffic-coating work.

B. Verify that substrates are visibly dry and free of moisture.

1. Test for moisture content by method recommended in writing by traffic-coating manufacturer.

C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of traffic-coating work.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

1. Begin coating application only after substrate construction and penetrating work have been completed.
2. Begin coating application only after minimum concrete-curing and -drying period recommended in writing by traffic-coating manufacturer has passed and after substrates are dry.
3. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Clean and prepare substrates according to ASTM C1127 and manufacturer's written instructions to produce clean, dust-free, dry substrate for traffic-coating application. Remove projections, fill voids, and seal joints if any, as recommended in writing by traffic-coating manufacturer.

B. Priming: Unless manufacturer recommends in writing against priming, prime substrates according to manufacturer's written instructions.

1. Limit priming to areas that will be covered by traffic-coating material on same day. Reprime areas exposed for more time than recommended by manufacturer.

C. Schedule preparation work so dust and other contaminants from process do not fall on wet, newly coated surfaces.

D. Mask adjoining surfaces not receiving traffic coatings to prevent overspray, spillage, leaking, and migration of coatings. Prevent traffic-coating materials from entering deck substrate penetrations and clogging weep holes and drains.

E. Concrete Substrates: Mechanically abrade surface to a uniform profile acceptable to manufacturer, according to ASTM D4259. Do not acid etch.

1. Remove grease, oil, paints, and other penetrating contaminants from concrete.
2. Remove concrete fins, ridges, and other projections.
3. Remove laitance, glaze, efflorescence, curing compounds, concrete hardeners, form-release agents, and other incompatible materials that might affect coating adhesion.
4. Remove remaining loose material to provide a sound surface, and clean surfaces according to ASTM D4258.

3.3 TERMINATIONS AND PENETRATIONS

A. Prepare vertical and horizontal surfaces at terminations and penetrations through traffic coatings and at expansion joints, drains, and sleeves according to ASTM C1127 and manufacturer's written instructions.

B. Provide sealant cants at penetrations and at reinforced and nonreinforced, deck-to-wall butt joints.

C. Terminate edges of deck-to-deck expansion joints with preparatory base-coat strip.

D. Install sheet flashings at deck-to-wall expansion and dynamic joints, and bond to deck and wall substrates according to manufacturer's written recommendations.

3.4 JOINT AND CRACK TREATMENT

A. Prepare, treat, rout, and fill joints and cracks in substrates according to ASTM C1127 and manufacturer's written recommendations. Before coating surfaces, remove dust and dirt from joints and cracks according to ASTM D4258.

1. Comply with recommendations in ASTM C1193 for joint-sealant installation.

B. Apply reinforcing strip in traffic-coating system where recommended in writing by traffic-coating manufacturer.

3.5 INSTALLATION OF TRAFFIC COATING

A. Apply traffic coating according to ASTM C1127 and manufacturer's written instructions.

B. Apply coats of specified compositions for each type of traffic coating at locations as indicated on Drawings.

C. Start traffic-coating application in presence of manufacturer's technical representative.

D. Verify that wet-film thickness of each coat complies with requirements every 600 sq. ft..

E. Uniformly broadcast and embed aggregate in each coat indicated to receive aggregate according to manufacturer's written instructions. After coat dries, sweep away excess aggregate.

F. Apply traffic coatings to prepared wall terminations and vertical surfaces to height indicated; omit aggregate on vertical surfaces.

G. Cure traffic coatings. Prevent contamination and damage during coating application and curing.

3.6 PROTECTING AND CLEANING

A. Protect traffic coatings from damage and wear during remainder of construction period.

B. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION

SECTION 07 19 00 - WATER REPELLENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Penetrating water repellents.

B. Related Requirements:

1. Section 03 45 00 “Precast Architectural Concrete” for precast concrete panels to receive water repellent coating.

1.2 ACTION SUBMITTALS

A. Product Data:

1. Penetrating water repellents.

B. Product Data Submittals:

1. Include manufacturer's printed statement of VOC content.
2. Include manufacturer's recommended number of coats for each type of substrate and spreading rate for each separate coat.

C. Samples: For each type of water repellent and substrate indicated, 12 by 12 inches in size, with specified water-repellent treatment applied to half of each Sample.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Applicator.

B. Product Certificates: For each type of water repellent.

C. Preconstruction Test Reports: For water-repellent-treated substrates.

D. Field quality-control reports.

E. Sample Warranty: For special warranty.

1.4 QUALITY ASSURANCE

A. Applicator Qualifications: An employer of workers trained and approved by manufacturer.

B. Mockups: Prepare mockups of each required water repellent on each type of substrate required to demonstrate aesthetic effects, for preconstruction testing, and to set quality standards for materials and execution.

1. Locate mockups in conjunction with integrated exterior wall mockups specified in Section 01 43 39 “Mockups.”.
2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

1.5 PRECONSTRUCTION TESTING

A. Preconstruction Testing: Engage a qualified testing agency to perform preconstruction testing of water repellents on integrated wall mockup specified in Section 01 43 39 “Mockups.”

1. In addition to verifying performance requirements, use mockups to verify manufacturer's written instructions for application procedure and optimum rates of product application to substrates.
2. Propose changes to materials and methods to suit Project.
3. Notify Architect seven days in advance of the dates and times when mockups will be tested.

1.6 FIELD CONDITIONS

A. Limitations: Proceed with application only when the following existing and forecasted weather and substrate conditions permit water repellents to be applied in accordance with manufacturers' written instructions and warranty requirements:

1. Building has been closed in for not less than 30 days before treating wall assemblies.
2. Ambient temperature is above 40 deg F and below 100 deg F and will remain so for 24 hours.
3. Substrate is not frozen and substrate-surface temperature is above 40 deg F and below 100 deg F.
4. Rain or snow is not predicted within 24 hours.
5. Not less than 24 hours have passed since surfaces were last wet.
6. Windy conditions do not exist that might cause water repellent to be blown onto vegetation or surfaces not intended to be treated.

1.7 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer and Applicator agree(s) to repair or replace materials that fail to maintain water repellency specified in "Performance Requirements" Article within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Performance: Water repellents must meet the following performance requirements as determined by testing on manufacturer's standard substrates representing those indicated for this Project.

B. Water Absorption: Minimum 90 percent reduction of water absorption after 24 hours for treated compared to untreated specimens when tested according to the following:

1. Precast Concrete: ASTM C642.

C. Water-Vapor Transmission: Comply with one or both of the following:

1. Maximum 10 percent reduction in water-vapor transmission of treated compared to untreated specimens, in accordance with ASTM E96/E96M.
2. Minimum 80 percent water-vapor transmission of treated compared to untreated specimens, in accordance with ASTM D1653.

D. Durability: Maximum 5 percent loss of water-repellent performance after 2500 hours of weathering in accordance with ASTM G154 compared to water-repellent-treated specimens before weathering.

E. Aesthetics: No visible change in surface color of substrate.

2.2 PENETRATING WATER REPELLENTS

A. Penetrating Low-VOC Silane/Siloxane-Blend Water Repellent: Clear, containing 10 percent or more active content of silane and siloxane blend with 400 g/L or less of VOCs.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Degussa Corp.; Protectosil Aqua-Trete EM.
b. Euclid Chemical Company (The); an RPM company; Chemstop WB Regular.
c. Laticrete International, Inc.; Aquapel Plus.
d. PROSOCO, Inc.; Siloxane PD.
e. Symons; a Brand of Dayton Superior Corporation; Siloxane/Silane 10%.
f. Tnemec Company, Inc.; Series 633 Prime-A-Pell H2O.

2. Location: Treat all precast architectural concrete panels.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Applicator present, for compliance with requirements and conditions affecting performance of the Work.

1. Verify that surfaces are clean and dry in accordance with water-repellent manufacturer's requirements. Check moisture content in three representative locations by method recommended by manufacturer.
2. Verify that there is no efflorescence or other removable residues that would be trapped beneath the application of water repellent.
3. Verify that required repairs are complete, cured, and dry before applying water repellent.

B. Test pH level in accordance with water-repellent manufacturer's written instructions to ensure chemical bond to silica-containing or siliceous minerals.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. New Construction and Repairs: Allow concrete and other cementitious materials to age before application of water repellent, in accordance with repellent manufacturer's written instructions.

B. Cleaning: Before application of water repellent, clean substrate of substances that could impair penetration or performance of product in accordance with water-repellent manufacturer's written instructions.

C. Protect adjoining work, including mortar and sealant bond surfaces, from spillage or blow-over of water repellent. Cover adjoining and nearby surfaces of aluminum and glass if there is the possibility of water repellent being deposited on surfaces. Cover live vegetation.

D. Coordination with Sealant Joints: Do not apply water repellent until sealants for joints adjacent to surfaces receiving water-repellent treatment have been installed and cured.

1. Water-repellent work may precede sealant application only if sealant adhesion and compatibility have been tested and verified using substrate, water repellent, and sealant materials identical to those required.

3.3 APPLICATION OF WATER REPELLENTS

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect the substrate before application of water repellent and to instruct Applicator on the product and application method to be used.

B. Apply coating of water repellent on surfaces to be treated using 15 psi-pressure spray with a fan-type spray nozzle to the point of saturation. Apply coating in dual passes of uniform, overlapping strokes. Remove excess material; do not allow material to puddle beyond saturation. Comply with manufacturer's written instructions for application procedure unless otherwise indicated.

1. Precast Concrete: At Contractor's option, first application of water repellent may be completed before installing units. Mask mortar and sealant bond surfaces to prevent water repellent from migrating onto joint surfaces. Remove masking after repellent has cured.

C. Apply a second saturation coating, repeating first application. Comply with manufacturer's written instructions for limitations on drying time between coats and after rainstorm wetting of

surfaces between coats. Consult manufacturer's technical representative if written instructions are not applicable to Project conditions.

3.4 FIELD QUALITY CONTROL

A. Testing of Water-Repellent Material: Owner reserves the right to invoke the following procedure at any time and as often as Owner deems necessary during the period when water repellent is being applied:

1. Owner will engage the services of a qualified testing agency to sample water-repellent material being used. Samples of material delivered to Project site will be taken, identified, sealed, and certified in presence of Contractor.
2. Testing agency will perform tests for compliance of water-repellent material with product requirements.
3. Owner may direct Contractor to stop applying water repellents if test results show material being used does not comply with product requirements. Contractor to remove noncomplying material from Project site, pay for testing, and correct deficiency of surfaces treated with rejected materials, as approved by Architect.

B. Coverage Test: In the presence of Architect, hose down a dry, repellent-treated surface to verify complete and uniform product application. A change in surface color will indicate incomplete application.

1. Notify Architect seven days in advance of the dates and times when surfaces will be tested.
2. Reapply water repellent until coverage test indicates complete coverage.

3.5 CLEANING

A. Immediately clean water repellent from adjoining surfaces and surfaces soiled or damaged by water-repellent application as work progresses. Correct damage to work of other trades caused by water-repellent application, as approved by Architect.

B. Comply with manufacturer's written cleaning instructions.

END OF SECTION

This page is intentionally left blank.

SECTION 07 21 00 - THERMAL INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Extruded polystyrene foam-plastic board insulation.
2. Polyisocyanurate foam-plastic board insulation.
3. Glass-fiber blanket insulation.
4. Mineral-wool board insulation.
5. Spray-applied glass fiber insulation.

B. Related Requirements:

1. Section 070513.13 “Rainscreen Cladding Support System" for thermally-broken girts installed with grooved polyisocyanurate foam-plastic board insulation.
2. Section 071413 "Hot Fluid-Applied Rubberized Asphalt Waterproofing" for insulated panels installed under vegetated roof assembly and plaza-deck pavers.
3. Section 072119 "Foamed-in-Place Insulation" for spray-applied polyurethane foam insulation.
4. Section 075419 "Polyvinyl-Chloride (PVC) Roofing" for insulation specified as part of roofing construction.
5. Section 092900 "Gypsum Board" for sound attenuation blanket used as acoustic insulation.

C. Product Data:

1. Extruded polystyrene foam-plastic board insulation.
2. Glass-fiber blanket insulation.
3. Mineral-wool board insulation.
4. Spray-applied glass fiber insulation.

D. Sustainable Design Submittals:

1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.
2. Environmental Product Declaration: For each product.
3. Health Product Declaration: For each product.
4. Sourcing of Raw Materials: Corporate sustainability report for each manufacturer.
5. Product Data: For adhesives, indicating VOC content.
6. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting materials.
7. Laboratory Test Reports: For insulation, indicating compliance with requirements for low-emitting materials.

1.2 INFORMATIONAL SUBMITTALS

A. Installer's Certification: Listing type, manufacturer, and R-value of insulation installed in each element of the building thermal envelope.

1. For spray-applied glass fiber insulation, indicate installed thickness to comply with required R-value.
2. Sign, date, and include the certification in Closeout documentation.

B. Product Test Reports: For each product, for tests performed by a qualified testing agency.

C. Research Reports: For foam-plastic insulation, from ICC-ES.

1.3 DELIVERY, STORAGE, AND HANDLING

A. Protect insulation materials from physical damage and from deterioration due to moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.

B. Protect foam-plastic board insulation as follows:

1. Do not expose to sunlight except to necessary extent for period of installation and concealment.
2. Protect against ignition at all times. Do not deliver foam-plastic board materials to Project site until just before installation time.
3. Quickly complete installation and concealment of foam-plastic board insulation in each area of construction.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Surface-Burning Characteristics: Maximum flame-spread and smoke-developed indexes less than 25 and 450 when tested in accordance with ASTM E84.

B. Fire-Resistance Ratings: Comply with ASTM E119 or UL 263; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Indicate design designations from UL's "Fire Resistance Directory" or from listings of another qualified testing agency.

C. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.

D. Labeling: Provide identification of mark indicating R-value of each piece of insulation 12 inches and wider in width.

E. Thermal-Resistance Value (R-Value): R-value as indicated on Drawings in accordance with ASTM C518.

F. Verify insulation complies with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

G. Verify adhesives have a VOC content of 70 g/L or less.

H. Recycled Content: Provide products with postconsumer recycled content plus one-half of preconsumer recycled content to the extent required to comply with the minimum criteria specified in Section 01 81 13.33 “Sustainable Design Requirements – IGCC/ASHRAE 189.1.”

2.2 EXTRUDED POLYSTYRENE FOAM-PLASTIC BOARD INSULATION

A. Extruded Polystyrene Board Insulation, Type IV: ASTM C578, Type IV, 25-psi minimum compressive strength; unfaced.

2.3 POLYISOCYANURATE FOAM-PLASTIC BOARD INSULATION

A. Polyisocyanurate Board Insulation, Foil Faced: ASTM C1289, foil faced, Type I, Class 1 or 2.

1. Basis-of-Design Product: Subject to compliance with requirements, provide **Hunter Panels; a Carlisle company; Xci Foil** or a comparable product by one of the following:

    a. Atlas Polyiso Roof and Wall Insulation.
    b. DuPont de Nemours, Inc.
    c. Elevate; Holcim Building Envelope.

2. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.

2.4 GLASS-FIBER BLANKET INSULATION

A. Glass-Fiber Blanket Insulation, Unfaced: ASTM C665, Type I; passing ASTM E136 for combustion characteristics.

2.5 MINERAL-WOOL BOARD INSULATION

A. Mineral-Wool, Exterior Board Insulation, Unfaced: ASTM C 612; with maximum flame-spread and smoke-developed indexes of 15 and zero, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics; designed for exterior cavity wall and rainscreen applications. Minimum nominal density of 4 lb/cu. ft.

1. Products: Subject to compliance with requirements, provide one of the following:

    a. Johns Manville; a Berkshire Hathaway company; JM CladStone™ Water & Fire Block.
    b. ROCKWOOL (ROXUL Inc.); CAVITYROCK.
    c. Thermafiber, Inc.; an Owens Corning company; RainBarrier 45.

B. Mineral-Wool, Curtain Wall Board Insulation, Types IA and IB, Foil-Faced: ASTM C612, Types IA and IB; faced on one side with foil-scrim or foil-scrim-polyethylene vapor retarder; with maximum flame-spread and smoke-developed indexes of 15 and zero, respectively, per ASTM E84. Nominal density of 4 lb/cu. ft..

1. Products: Subject to compliance with requirements, provide one of the following:

a. ROCKWOOL (ROXUL Inc.); CURTAINROCK 40.
b. Thermafiber, Inc.; an Owens Corning company; FireSpan 40.

2.6 SPRAY-APPLIED GLASS FIBER INSULATION

A. Self-Supported, Spray-Applied Glass Fiber Insulation: Inorganic, mineral not containing asbestos, free crystalline silica, or combustible fibers; insulation to be vermin and rot proof, completely free from biological degeneration, and exhibit the following properties:

1. Basis-of-Design Product: Subject to compliance with requirements, provide **Monoglass; Spray-On** or comparable product by one of the following:

a. American Energy Products; Spraydon Type II.
b. Isotatek International Corp.; Cafco Heat-Shield.
c. Thermacoustic; TC-417.

2. Fire Hazard Classification: ASTM E 84; Class A.

a. Flame Spread: 15.
b. Fuel Contribution: 15.
c. Smoke Developed: 0.

3. Combustibility: ASTM E 136; Non-combustible.
4. Air Erosion: ASTM E 859; No mass loss.
5. Dry Density: ASTM D 1622; 3.0 lbs./cu. ft.
6. Thermal Resistance: R-Value of 4.00/inch of thickness.
7. Fungus & Bacterial Resistance: ASTM G 21; No growth supported.
8. Color: White.

2.7 INSULATION FASTENERS

A. Adhesively Attached, Spindle-Type Anchors: Plate welded to projecting spindle; capable of holding insulation of specified thickness securely in position with self-locking washer in place.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. AGM Industries, Inc.
b. Gemco.

2. Plate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
3. Spindle: Copper-coated, low-carbon steel; fully annealed; 0.105 inch in diameter; length to suit depth of insulation.

B. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick galvanized-steel sheet, with beveled edge for increased stiffness, sized as required to hold insulation securely in place, but not less than 1-1/2 inches square or in diameter.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. AGM Industries, Inc.
b. Gemco.

2. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in the following locations:

a. Ceiling plenums.
b. Exposed parking areas.

C. Anchor Adhesive: Product with demonstrated capability to bond insulation anchors securely to substrates without damaging insulation, fasteners, or substrates.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. AGM Industries, Inc.
b. Gemco.

2.8 ACCESSORIES

A. Insulation for Miscellaneous Voids:

1. Glass-Fiber Insulation: ASTM C764, Type II, loose fill; with maximum flame-spread and smoke-developed indexes of 5, per ASTM E84.
2. Spray Polyurethane Foam Insulation: ASTM C1029, Type II, closed cell, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, per ASTM E84.
3. Polyurethane Pour-In-Place Insulation: Closed cell, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, per ASTM E84, specifically formulated for pour-in-place applications.

B. Adhesive for Bonding Insulation: Product compatible with insulation and air and water barrier materials, and with demonstrated capability to bond insulation securely to substrates without damaging insulation and substrates.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean substrates of substances that are harmful to insulation, including removing projections capable of puncturing insulation or vapor retarders, or that interfere with insulation attachment.

3.2 INSTALLATION, GENERAL

A. Comply with insulation manufacturer's written instructions applicable to products and applications.

B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.

C. Install insulation with manufacturer's R-value label exposed after insulation is installed.

D. Extend insulation to envelop entire area to be insulated. Fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.

E. Provide sizes to fit applications and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units unless multiple layers are otherwise shown or required to make up total thickness or to achieve R-value.

3.3 INSTALLATION OF FOUNDATION WALL INSULATION

A. Butt panels together for tight fit.

B. Adhesive Installation: Install with adhesive or press into tacky waterproofing or dampproofing according to manufacturer's written instructions.

3.4 INSTALLATION OF RAIN SCREEN WALL INSULATION

A. Mineral-Wool Board Insulation: Install insulation fasteners 4 inches from each corner of board insulation, at center of board, and as recommended by manufacturer.

1. Fit courses of insulation between composite framing cladding support subframing and other obstructions, with edges butted tightly in both directions, and with faces flush.
2. Press units firmly against inside substrates.

B. Polyisocyanurate Board Insulation: Install as follows:

1. Fit courses of insulation between composite framing cladding support subframing specified in Section 07 05 43.13 “Rainscreen Cladding Support System” and other obstructions, with edges grooved to match composite girt profile and butted tightly in both directions, and with faces flush.

3.5 INSTALLATION OF INSULATION IN FRAMED CONSTRUCTION

A. Blanket Insulation: Install in cavities formed by framing members according to the following requirements:

1. Use insulation widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill the cavities, provide lengths that will produce a snug fit between ends.
2. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.

3. Maintain 3-inch clearance of insulation around recessed lighting fixtures not rated for or protected from contact with insulation.
4. For metal-framed wall cavities where cavity heights exceed 96 inches, support unfaced blankets mechanically and support faced blankets by taping flanges of insulation to flanges of metal studs.

B. Miscellaneous Voids: Install insulation in miscellaneous voids and cavity spaces where required to prevent gaps in insulation using the following materials:

1. Glass-Fiber Insulation: Compact to approximately 40 percent of normal maximum volume equaling a density of approximately 2.5 lb/cu. ft..
2. Spray Polyurethane Insulation: Apply according to manufacturer's written instructions.

3.6 INSTALLATION OF SPRAY-APPLIED GLASS FIBER INSULATION

A. Install spray-applied glass fiber insulation according to manufacturer’s written instructions.

B. Provide manufacturer’s recommended supplemental anchors or brackets to support insulation when thickness exceeds the self-supporting depth recommended by the manufacturer.

3.7 INSTALLATION OF CURTAIN-WALL INSULATION

A. Install board insulation in curtain-wall construction according to curtain-wall manufacturer's written instructions.

1. Hold insulation in place by securing metal clips and straps or integral pockets within window frames, spaced at intervals recommended in writing by insulation manufacturer to hold insulation securely in place without touching spandrel glass.
2. Maintain cavity width of dimension indicated on Drawings between insulation and glass.
3. Install insulation to fit snugly without bowing.

3.8 PROTECTION

A. Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes.

B. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

END OF SECTION

This page is intentionally left blank.

SECTION 07 21 19 - FOAMED-IN-PLACE INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Closed-cell spray polyurethane foam insulation.
2. Spray-applied thermal barrier.
3. Accessories.

B. Related Requirements:

1. Section 072100 "Thermal Insulation" for foam-plastic board insulation.

1.2 ACTION SUBMITTALS

A. Product Data:

1. Closed-cell spray polyurethane foam insulation.
2. Spray-applied thermal barrier.
3. Accessories.

B. Sustainable Design Submittals:

1. Manufacturer Inventory: Provide manufacturer's ingredient inventory.
2. Health Product Declaration (HPD): Provide documentation confirming product compliance with one of the following:

    a. Inventory or HPD to at least 0.01 percent by weight, with at least 95 percent assessed using GreenScreen Benchmark assessment.
    b. Cradle to Cradle v3 certification with minimum Silver level of Material Health.
    c. Living Product Challenge certification indicating achievement of Imperative 09, "Transparent Material Health."

3. Laboratory Test Reports: For insulation, indicating compliance with requirements for low-emitting materials.

1.3 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For each product, for tests performed by qualified testing agency.

B. Research Reports:

1. For spray-applied polyurethane foam-plastic insulation, from ICC-ES showing compliance with 2018 IBC.

2. For spray-applied thermal barrier, from independent testing laboratory showing compliance with NFPA 275.

C. Field quality-control reports.

D. Qualification Statements: For Installer.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

PART 2 - PRODUCTS

2.1 CLOSED-CELL SPRAY POLYURETHANE FOAM INSULATION

A. Closed-Cell Spray Polyurethane Foam: ASTM C1029, Type II, minimum density of 2.0 lb/cu. ft. and minimum aged R-value at 1-inch thickness of 6.2 deg F x h x sq. ft./Btu at 75 deg F.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Carlisle Spray Foam Insulation.
b. Gaco; a brand of Firestone Building Products.
c. Henry Company.
d. Huntsman Building Solutions.
e. Johns Manville; a Berkshire Hathaway company.
f. NCFI Polyurethanes; a division of Barnhardt Manufacturing Company.
g. SWD Urethane Company.

2. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

a. Flame-Spread Index: 25 or less.
b. Smoke-Developed Index: 450 or less.

2.2 ACCESSORIES

A. Primer: Material recommended by insulation manufacturer where required for adhesion of insulation to substrates.

B. Thermal Barrier: Material barrier intended to prevent flame-source access to foam and delay temperature-rise of foam during a fire event.

1. Thermal Barrier Coating: Fire-protective intumescent coating formulated for application over polyurethane foam plastics, compatible with insulation, and passes NFPA 275 testing as part of an approved assembly.

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) Flame Control Coatings, LLC.
2) International Fireproof Technology Inc.
3) No-Burn, Inc.
4) TPR2 Corporation.

2. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

a. Flame-Spread Index: 25 or less.
b. Smoke-Developed Index: 50 or less.

PART 3 - EXECUTION

3.1 PREPARATION

A. Verify that substrates are clean, dry, and free of substances that are harmful to insulation.

B. Priming: Prime substrates where recommended by insulation manufacturer. Apply primer to comply with insulation manufacturer's written instructions. Confine primers to areas to be insulated; do not allow spillage or migration onto adjoining surfaces.

3.2 INSTALLATION

A. Comply with insulation manufacturer's written instructions applicable to products and applications.

B. Spray insulation to envelop entire area to be insulated and fill voids.

C. Apply in multiple passes to not exceed maximum thicknesses recommended by manufacturer. Do not spray into rising foam.

D. Miscellaneous Voids: Apply according to manufacturer's written instructions.

E. Install thermal barrier material.

1. Do not cover insulation prior to any required spray foam insulation inspections.

F. Apply barrier coatings in accordance with manufacturer's written instructions and to comply with requirements for listing and labeling for fire-propagation characteristics and surface-burning characteristics specified.

1. Use equipment and techniques best suited for substrate and type of material applied as recommended by coating manufacturer.
2. Apply coatings to prepared surfaces as soon as practical after preparation and before subsequent surface soiling or deterioration.

3. Apply coatings to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Produce sharp lines and color breaks.

3.3 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect spray foam insulation installation, including accessories. Report results in writing.

3.4 PROTECTION

A. Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes.

END OF SECTION

SECTION 07 27 13 - MODIFIED BITUMINOUS SHEET AIR BARRIERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Self-adhering, vapor-retarding, air barrier.

1. Modified bituminous sheet.

B. Related Requirements:

1. Section 06 16 00 "Sheathing" for wall sheathings and wall sheathing joint-and-penetration treatments.

1.2 DEFINITIONS

A. Air-Barrier Accessory: A transitional component of the air barrier that provides continuity.

B. Air-Barrier Assembly: The collection of air-barrier materials and accessories applied to an opaque wall, including joints and junctions to abutting construction, to control air movement through the wall.

C. Air-Barrier Material: A primary element that provides a continuous barrier to the movement of air.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review air-barrier requirements and installation, special details, mockups, air-leakage and bond testing, air-barrier protection, and work scheduling that covers air barriers.

1.4 ACTION SUBMITTALS

A. Product Data: Self-adhering, vapor-retarding, sheet air barrier. Include manufacturer's written instructions for evaluating, preparing, and treating each substrate; technical data; and tested physical and performance properties of products.

1. Modified bituminous sheet.

B. Shop Drawings: For air-barrier assemblies.

1. Show locations and extent of air barrier materials, accessories, and assemblies specific to Project conditions.

2. Include details for substrate joints and cracks, counterflashing strips, penetrations, inside and outside corners, terminations, and tie-ins with adjoining construction.
3. Include details of interfaces with other materials that form part of air barrier.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Certificates: From air-barrier manufacturer, certifying compatibility of air barriers and accessory materials with Project materials that connect to or that come in contact with air barrier.

C. Product Test Reports: For each air-barrier assembly, for tests performed by a qualified testing agency.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Remove and replace liquid materials that cannot be applied within their stated shelf life.

B. Protect stored materials from direct sunlight.

1.8 FIELD CONDITIONS

A. Environmental Limitations: Apply air barrier within the range of ambient and substrate temperatures recommended in writing by air-barrier manufacturer.

1. Protect substrates from environmental conditions that affect air-barrier performance.
2. Do not apply air barrier to a damp or wet substrate or during snow, rain, fog, or mist.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Obtain primary air-barrier materials and air-barrier accessories from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Air-Barrier Performance: Air-barrier assembly and seals with adjacent construction to be capable of performing as a continuous air barrier and as a liquid-water drainage plane flashed

to discharge to the exterior incidental condensation or water penetration. Air-barrier assemblies to be capable of accommodating substrate movement and of sealing substrate expansion and control joints, construction material changes, penetrations, tie-ins to installed waterproofing, and transitions at perimeter conditions without deterioration and air leakage exceeding specified limits.

B. Air-Barrier Assembly Air Leakage: Maximum 0.04 cfm/sq. ft. of surface area at 1.57 lbf/sq. ft., when tested in accordance with ASTM E2357.

2.3 SELF-ADHERING SHEET AIR BARRIER

A. Modified Bituminous Sheet: 40-mil-thick, self-adhering sheet consisting of 36 mils of rubberized asphalt laminated to a 4-mil-thick, cross-laminated polyethylene film with release liner on adhesive side.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Carlisle Coatings & Waterproofing Inc.
    b. GCP Applied Technologies Inc.
    c. Henry Company.
    d. Tremco Incorporated.
    e. W. R. Meadows, Inc.

2. Physical and Performance Properties:

    a. Air Permeance: Maximum 0.004 cfm/sq. ft. of surface area at 1.57-lbf/sq. ft. pressure difference; ASTM E2178.
    b. Tensile Strength: Minimum 250 psi; ASTM D412, Die C.
    c. Ultimate Elongation: Minimum 200 percent; ASTM D412, Die C.
    d. Puncture Resistance: Minimum 40 lbf; ASTM E154/E154M.
    e. Water Absorption: Maximum 0.15 percent weight gain after 48-hour immersion at 70 deg F; ASTM D570.
    f. Vapor Permeance: Maximum 0.1 perm; ASTM E96/E96M, Desiccant Method.
    g. Adhesion to Substrate: Minimum 16 lbf/sq. in. when tested in accordance with ASTM D4541 as modified by ABAA.
    h. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.
    i. UV Resistance: Can be exposed to sunlight for 90 days in accordance with manufacturer's written instructions.

2.4 ACCESSORY MATERIALS

A. Requirement: Provide primers, transition strips, termination strips, joint sealants, counterflashing strips, flashing sheets and metal termination bars, termination mastic, substrate patching materials, adhesives, tapes, foam sealants, lap sealants, and other accessory materials that are recommended in writing by air-barrier manufacturer to produce a complete air-barrier assembly and that are compatible with primary air-barrier material and adjacent construction to which they may seal.

B. Primer: Liquid primer recommended for substrate by air-barrier material manufacturer.

C. Stainless Steel Sheet: ASTM A240/A240M, Type 304, 0.0187 inch thick, and Series 300 stainless steel fasteners.

D. Preformed Silicone Extrusion: Manufacturer's standard system consisting of cured low-modulus silicone extrusion, sized to fit opening widths, with a single-component, neutral-curing, Class 100/50 (low-modulus) silicone sealant for bonding extrusions to substrates.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. GE Construction Sealants; Momentive Performance Materials Inc.
b. The Dow Chemical Company.
c. Tremco Incorporated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.

1. Verify that substrates are sound and free of oil, grease, dirt, excess mortar, or other contaminants.
2. Verify that substrates have cured and aged for minimum time recommended in writing by air-barrier manufacturer.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 SURFACE PREPARATION

A. Clean, prepare, treat, fill, and seal substrate and joints and cracks in substrate in accordance with manufacturer's written instructions and details. Provide clean, dust-free, and dry substrate for air-barrier application.

B. Mask off adjoining surfaces not covered by air barrier to prevent spillage and overspray affecting other construction.

C. Remove grease, oil, bitumen, form-release agents, paints, curing compounds, and other penetrating contaminants or film-forming coatings from concrete.

D. At changes in substrate plane, apply sealant or termination mastic beads at sharp corners and edges to form a smooth transition from one plane to another.

E. Cover gaps in substrate plane and form a smooth transition from one substrate plane to another with stainless steel sheet mechanically fastened to structural framing to provide continuous support for air barrier.

3.3 INSTALLATION OF SELF-ADHERING SHEET AIR BARRIER

A. Install materials in accordance with air-barrier manufacturer's written instructions and details and in accordance with recommendations in ASTM D6135 to form a seal with adjacent construction and ensure continuity of air and water barrier.

1. When ambient and substrate temperatures range between 25 and 40 deg F, install self-adhering, modified bituminous air-barrier sheet produced for low-temperature application. Do not install low-temperature sheet if ambient or substrate temperature is higher than 60 deg F.
2. Unless manufacturer recommends in writing against priming, apply primer to substrates at required rate and allow it to dry.

B. Prepare, treat, and seal inside and outside corners and vertical and horizontal surfaces at terminations and penetrations with termination mastic and in accordance with ASTM D6135.

C. Apply primer to substrates at required rate and allow it to dry. Limit priming to areas that will be covered by air-barrier sheet on same day. Reprime areas exposed for more than 24 hours.

D. Apply and firmly adhere air-barrier sheets over area to receive air barrier. Accurately align sheets and maintain uniform 2-1/2-inch-minimum lap widths and end laps. Overlap and seal seams, and stagger end laps to ensure airtight installation.

1. Apply sheets in a shingled manner to shed water.
2. Roll sheets firmly to enhance adhesion to substrate.

E. Apply continuous air-barrier sheets over accessory strips bridging substrate cracks, construction, and contraction joints.

F. Seal top of through-wall flashings to air-barrier sheet with an additional 6-inch-wide, transition strip.

G. Seal exposed edges of sheet at seams, cuts, penetrations, and terminations not concealed by metal counterflashings or ending in reglets with termination mastic.

H. Install air-barrier sheet and accessory materials to form a seal with adjacent construction and to maintain a continuous air barrier.

1. Coordinate air-barrier installation with installation of roofing membrane and base flashing to ensure continuity of air barrier with roofing membrane.
2. Install transition strip on roofing membrane or base flashing so that a minimum of 3 inches of coverage is achieved over each substrate.

I. Connect and seal exterior wall air-barrier sheet continuously to roofing-membrane air barrier, concrete below-grade structures, floor-to-floor construction, exterior glazing and window systems, glazed curtain-wall systems, storefront systems, exterior louvers, exterior door framing, and other construction used in exterior wall openings, using accessory materials.

J. At end of each working day, seal top edge of air-barrier material to substrate with termination mastic.

K. Apply joint sealants forming part of air-barrier assembly within manufacturer's recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.

L. Wall Openings: Detail according to manufacturer’s published installation details.

M. Fill gaps in perimeter frame surfaces of windows, curtain walls, storefronts, doors, and miscellaneous penetrations of air-barrier material with foam sealant.

N. Repair punctures, voids, and deficient lapped seams in air barrier. Slit and flatten fishmouths and blisters. Patch with air-barrier sheet extending 6 inches beyond repaired areas in all directions.

O. Do not cover air barrier until it has been tested and inspected by testing agency.

P. Correct deficiencies in or remove air barrier that does not comply with requirements; repair substrates and reapply air-barrier components.

3.4 CLEANING AND PROTECTION

A. Protect air-barrier system from damage during application and remainder of construction period, in accordance with manufacturer's written instructions.

1. Protect air barrier from exposure to UV light and harmful weather exposure as recommended in writing by manufacturer. If exposed to these conditions for longer than recommended, remove and replace air barrier or install additional, full-thickness, air-barrier application after repairing and preparing the overexposed materials in accordance with air-barrier manufacturer's written instructions.
2. Protect air barrier from contact with incompatible materials and sealants not approved by air-barrier manufacturer.

B. Clean spills, stains, and soiling from construction that would be exposed in the completed Work, using cleaning agents and procedures recommended in writing by manufacturer of affected construction.

END OF SECTION

SECTION 07 42 13.13 - FORMED METAL WALL PANELS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Concealed-fastener, lap-seam metal wall panels.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Meet with Owner, Architect, metal panel Installer, metal panel manufacturer's representative, structural-support Installer, and installers whose work interfaces with or affects metal panels, including installers of doors, windows, and louvers.
2. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
3. Review methods and procedures related to metal panel installation, including manufacturer's written instructions.
4. Examine support conditions for compliance with requirements, including alignment between and attachment to structural members.
5. Review flashings, special siding details, wall penetrations, openings, and condition of other construction that affect metal panels.
6. Review governing regulations and requirements for insurance, certificates, and tests and inspections if applicable.
7. Review of procedures for repair of metal panels damaged after installation.
8. Document proceedings, including corrective measures and actions required, and furnish copy of record to each participant.

1.3 ACTION SUBMITTALS

A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of panel and accessory.

1. Concealed-fastener, lap-seam metal wall panels.

B. Sustainable Design Submittals:

1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.
2. Environmental Product Declaration: For each product.
3. Health Product Declaration: For each product.
4. Sourcing of Raw Materials: Corporate sustainability report for each manufacturer.

C. Shop Drawings:

1. Include fabrication and installation layouts of metal panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, trim, flashings, closures, and accessories; and special details.
2. Accessories: Include details of the flashing, trim, and anchorage systems, at a scale of not less than 1-1/2 inches per 12 inches.

D. Samples for Verification: For each type of exposed finish, prepared on Samples of size indicated below:

1. Metal Panels: 12 inches long by actual panel width. Include fasteners, closures, and other metal panel accessories.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Test Reports: For concealed-fastener, lap-seam metal wall panels, for tests performed by a qualified testing agency.

C. Sample Warranties: For special warranties.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For metal panels to include in maintenance manuals.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

1.7 MOCKUPS

A. Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.

1. Build mockup of typical metal panel assembly 20 feet long by full height of wall, including corner, supports, attachments, and accessories.
2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver components, metal panels, and other manufactured items so as not to be damaged or deformed. Package metal panels for protection during transportation and handling.

B. Unload, store, and erect metal panels in a manner to prevent bending, warping, twisting, and surface damage.

C. Stack metal panels horizontally on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal panels to ensure dryness, with positive slope for drainage of water. Do not store metal panels in contact with other materials that might cause staining, denting, or other surface damage.

D. Retain strippable protective covering on metal panels during installation.

1.9 FIELD CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of metal panels to be performed according to manufacturers' written instructions and warranty requirements.

1.10 COORDINATION

A. Coordinate metal panel installation with rain drainage work, flashing, trim, construction of soffits, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.11 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal panel systems that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures including rupturing, cracking, or puncturing.
b. Deterioration of metals and other materials beyond normal weathering.

2. Warranty Period: Two years from date of Substantial Completion.

B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal panels that show evidence of deterioration of factory-applied finishes within specified warranty period.

1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:

a. Color fading more than 5 Delta E units when tested according to ASTM D2244.
b. Chalking in excess of a No. 8 rating when tested according to ASTM D4214.
c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Recycled Content: Provide products with postconsumer recycled content plus one-half of preconsumer recycled content to the extent required to comply with the minimum criteria specified in Section 01 81 13.14 “Sustainable Design Requirements.”

B. Structural Performance: Provide metal panel systems capable of withstanding the effects of the following loads, based on testing according to ASTM E1592:

1. Wind Loads: As indicated on Drawings.
2. Deflection Limits: For wind loads, no greater than 1/180 of the span.

C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

2.2 CONCEALED-FASTENER, LAP-SEAM METAL WALL PANELS

A. Provide factory-formed metal panels designed to be field assembled by lapping and interconnecting side edges of adjacent panels and mechanically attaching through panel to supports using concealed fasteners in side laps. Include accessories required for weathertight installation.

B. Flush-Profile, Concealed-Fastener Metal Wall Panels: Formed with vertical panel edges and a flat pan between panel edges; with flush joint between panels.

1. Basis-of-Design Product: Subject to compliance with requirements, provide **CENTRIA, a Nucor Brand; IW Series: IW-40A** or a comparable product by one of the following:

a. AEP Span a brand of ASC Profiles LLC, a part of BlueScope.
b. Englert, Inc.
c. Fabral; a brand of OmniMax International.
d. MBCI; Cornerstone Building Brands.
e. Morin - A Kingspan Group Company.
f. PAC-CLAD; Petersen Aluminum Corporation; a Carlisle company.

2. Metallic-Coated Steel Sheet: Zinc-coated (galvanized) steel sheet complying with ASTM A653/A653M, G90 coating designation, or aluminum-zinc alloy-coated steel sheet complying with ASTM A792/A792M, Class AZ50 coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A755/A755M.

a. Nominal Thickness: 0.038 inch (22 gage).
b. Exterior Finish: Two-coat fluoropolymer.
c. Color: As preselected and indicated in Finish Schedule.

3. Panel Coverage: 12 inches.

4. Panel Height: 1.5 inches.
5. Reveal Height: 1 inch.

2.3 MISCELLANEOUS MATERIALS

A. Miscellaneous Metal Subframing and Furring: ASTM C645, cold-formed, metallic-coated steel sheet, ASTM A653/A653M, G90 hot-dip galvanized coating designation or ASTM A792/A792M, Class AZ50 aluminum-zinc-alloy coating designation unless otherwise indicated. Provide manufacturer's standard sections as required for support and alignment of metal panel system.

B. Panel Accessories: Provide components required for a complete, weathertight panel system including trim, copings, fasciae, mullions, sills, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal panels unless otherwise indicated.

1. Closures: Provide closures at eaves and rakes, fabricated of same metal as metal panels.
2. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.
3. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch-thick, flexible closure strips; cut or premolded to match metal panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.

C. Flashing and Trim: Provide flashing and trim formed from same material as metal panels as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, bases, drips, sills, jambs, corners, endwalls, framed openings, rakes, fasciae, parapet caps, soffits, reveals, and fillers. Finish flashing and trim with same finish system as adjacent metal panels.

D. Panel Fasteners: Self-tapping screws designed to withstand design loads. Provide exposed fasteners with heads matching color of metal panels by means of plastic caps or factory-applied coating. Provide EPDM or PVC sealing washers for exposed fasteners.

E. Panel Sealants: Provide sealant type recommended by manufacturer that are compatible with panel materials, are nonstaining, and do not damage panel finish.

1. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch wide and 1/8 inch thick.
2. Joint Sealant: ASTM C920; elastomeric polyurethane or silicone sealant; of type, grade, class, and use classifications required to seal joints in metal panels and remain weathertight; and as recommended in writing by metal panel manufacturer.
3. Butyl-Rubber-Based, Solvent-Release Sealant: ASTM C1311.

2.4 FABRICATION

A. Fabricate and finish metal panels and accessories at the factory, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.

B. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel.

C. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's recommendations and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated.

1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
2. Seams for Other Than Aluminum: Fabricate nonmoving seams in accessories with flat-lock seams. Tin edges to be seamed, form seams, and solder.
3. Sealed Joints: Form non-expansion, but movable, joints in metal to accommodate sealant and to comply with SMACNA standards.
4. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.
5. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal recommended in writing by metal panel manufacturer.

a. Size: As recommended by SMACNA's "Architectural Sheet Metal Manual" or metal wall panel manufacturer for application but not less than thickness of metal being secured.

2.5 FINISHES

A. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

C. Steel Panels and Accessories:

1. Two-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent polyvinylidene fluoride (PVDF) resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
2. Concealed Finish: Apply pretreatment and manufacturer's standard white or light-colored acrylic or polyester backer finish consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal panel supports, and other conditions affecting performance of the Work.

1. Examine wall framing to verify that girts, angles, channels, studs, and other structural panel support members and anchorage have been installed within alignment tolerances required by metal wall panel manufacturer.

a. Where indicated, verify that air- or water-resistive barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.

B. Examine roughing-in for components and systems penetrating metal panels to verify actual locations of penetrations relative to seam locations of metal panels before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Miscellaneous Supports: Install composite cladding support subframing, furring, and other miscellaneous panel support members and anchorages according to ASTM C754 and metal panel manufacturer's written recommendations.

3.3 INSTALLATION OF METAL PANELS

A. Install metal panels according to manufacturer's written instructions in orientation, sizes, and locations indicated. Install panels perpendicular to supports unless otherwise indicated. Anchor metal panels and other components of the Work securely in place, with provisions for thermal and structural movement.

1. Shim or otherwise plumb substrates receiving metal panels.
2. Flash and seal metal panels at perimeter of all openings. Fasten with self-tapping screws. Do not begin installation until air- or water-resistive barriers and flashings that will be concealed by metal panels are installed.
3. Install screw fasteners in predrilled holes.
4. Locate and space fastenings in uniform vertical and horizontal alignment.
5. Install flashing and trim as metal panel work proceeds.
6. Locate panel splices over, but not attached to, structural supports. Stagger panel splices and end laps to avoid a four-panel lap splice condition.
7. Align bottoms of metal panels and fasten with blind rivets, bolts, or self-tapping screws. Fasten flashings and trim around openings and similar elements with self-tapping screws.
8. Provide weathertight escutcheons for pipe- and conduit-penetrating panels.

B. Fasteners:

1. Steel Panels: Use stainless steel fasteners for surfaces exposed to the exterior; use galvanized-steel fasteners for surfaces exposed to the interior.

C. Metal Protection: Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action as recommended in writing by metal panel manufacturer.

D. Accessory Installation: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.

1. Install components required for a complete metal panel system including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items. Provide types indicated by metal wall panel manufacturer; or, if not indicated, provide types recommended by metal panel manufacturer.

E. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that are permanently watertight.

1. Install exposed flashing and trim that is without buckling and tool marks, and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and achieve waterproof performance.
2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with mastic sealant (concealed within joints).

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Water-Spray Test: After installation, test area of assembly as directed by Architect for water penetration according to AAMA 501.2.

C. Remove and replace metal wall panels where tests and inspections indicate that they do not comply with specified requirements.

D. Additional tests and inspections, at Contractor's expense, are performed to determine compliance of replaced or additional work with specified requirements.

E. Prepare test and inspection reports.

3.5 CLEANING AND PROTECTION

A. Remove temporary protective coverings and strippable films, if any, as metal panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On completion of metal panel installation, clean finished surfaces as recommended by metal panel manufacturer. Maintain in a clean condition during construction.

B. After metal panel installation, clear weep holes and drainage channels of obstructions, dirt, and sealant.

C. Replace metal panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION

This page is intentionally left blank.

SECTION 07 54 19 - POLYVINYL-CHLORIDE (PVC) ROOFING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Polyvinyl chloride (PVC) roofing system.
2. Accessory roofing materials.
3. Substrate board.
4. Vapor retarder.
5. Roof insulation.
6. Insulation accessories and cover board.
7. Electronic leak detection (ELD) materials.
8. Walkways.

B. Related Requirements:

1. Section 06 10 00 "Rough Carpentry" for wood nailers, curbs, and blocking.
2. Section 07 62 00 "Sheet Metal Flashing and Trim" for metal roof flashings and counterflashings.
3. Section 07 92 00 "Joint Sealants" for joint sealants, joint fillers, and joint preparation.

1.2 DEFINITIONS

A. Roofing Terminology: Definitions in ASTM D1079 and glossary in NRCA's "The NRCA Roofing Manual: Membrane Roof Systems" apply to Work of this Section.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Roofing Conference: Conduct conference at Project site.

1. Meet with Owner, Architect, testing and inspecting agency representative, roofing Installer, roofing system manufacturer's representative, deck Installer, air barrier Installer, and installers whose work interfaces with or affects roofing, including installers of roof accessories and roof-mounted equipment.
2. Review methods and procedures related to roofing installation, including manufacturer's written instructions.
3. Review and finalize construction schedule, and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
4. Examine deck substrate conditions and finishes for compliance with requirements, including flatness and fastening.
5. Review structural loading limitations of roof deck during and after roofing.
6. Review base flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that affects roofing system.
7. Review governing regulations and requirements for insurance and certificates if applicable.

8. Review temporary protection requirements for roofing system during and after installation.
9. Review roof observation and repair procedures after roofing installation.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. For insulation and roof system component fasteners, include copy of FM Approvals' RoofNav listing.

B. Sustainable Design Submittals:

1. Product Test Reports: For roof materials, documentation indicating that roof materials comply with Solar Reflectance Index requirements.
2. Product Data: For adhesives and sealants, indicating VOC content.
3. Laboratory Test Reports: For adhesives and sealants, indicating compliance with requirements for low-emitting materials.
4. Environmental Product Declaration: For each product.

C. Shop Drawings: Include roof plans, sections, details, and attachments to other work, including the following:

1. Layout and thickness of insulation.
2. Base flashings and membrane termination details.
3. Flashing details at penetrations.
4. Tapered insulation layout, thickness, and slopes.
5. Roof plan showing orientation of steel roof deck and orientation of roof membrane.
6. Insulation fastening patterns for corner, perimeter, and field-of-roof locations.
7. Tie-in with adjoining air barrier.

D. Samples for Verification: For the following products:

1. Roof membrane and flashings, of color required.

E. Wind Uplift Resistance Submittal: For roofing system, indicating compliance with wind uplift performance requirements.

F. Qualification Data: For Installer and manufacturer.

G. Manufacturer Certificates:

1. Performance Requirement Certificate: Signed by roof membrane manufacturer, certifying that roofing system complies with requirements specified in "Performance Requirements" Article.

a. Submit evidence of compliance with performance requirements.

2. Special Warranty Certificate: Signed by roof membrane manufacturer, certifying that all materials supplied under this Section are acceptable for special warranty.

H. Product Test Reports: For roof membrane and insulation, for tests performed by a qualified testing agency, indicating compliance with specified requirements.

I. Evaluation Reports: For components of roofing system, from ICC-ES.

J. Sample Warranties: For manufacturer's special warranties.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For roofing system to include in maintenance manuals.

1.6 QUALITY ASSURANCE

A. Qualifications:

1. Manufacturers: A qualified manufacturer that is listed in FM Approvals' RoofNav for roofing system identical to that used for this Project.
2. Installers: A qualified firm that is approved, authorized, or licensed by roofing system manufacturer to install manufacturer's product and that is eligible to receive manufacturer's special warranty.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver roofing materials to Project site in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, approval or listing agency markings, and directions for storing and mixing with other components.

B. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by roofing system manufacturer. Protect stored liquid material from direct sunlight.

1. Discard and legally dispose of liquid material that cannot be applied within its stated shelf life.

C. Protect roof insulation materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources. Store in a dry location. Comply with insulation manufacturer's written instructions for handling, storing, and protecting during installation.

D. Handle and store roofing materials, and place equipment in a manner to avoid permanent deflection of deck.

1.8 FIELD CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit roofing system to be installed according to manufacturer's written instructions and warranty requirements.

1.9 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of roofing system that fail in materials or workmanship within specified warranty period.

1. Special warranty includes roof membrane, base flashings, roof insulation, fasteners, cover boards, vapor retarder, substrate board, and other components of roofing system.
2. Maximum Peak Gust Wind Speed: 110 mph.
3. Warranty Period: 25 years from date of Substantial Completion.

B. Special Project Warranty: Submit roofing Installer's warranty, on warranty form at end of this Section, signed by Installer, covering the Work of this Section, including all components of roofing system such as roof membrane, base flashing, roof insulation, fasteners, cover boards, substrate boards, and vapor retarders for the following warranty period:

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. General Performance: Installed roofing and base flashings to withstand specified uplift pressures, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Roof system and flashings to remain watertight.

1. Accelerated Weathering: Roof membrane to withstand 2000 hours of exposure when tested according to ASTM G152, ASTM G154, or ASTM G155.
2. Impact Resistance: Roof membrane to resist impact damage when tested according to ASTM D3746, ASTM D4272/D4272M, or the "Resistance to Foot Traffic Test" in FM Approvals 4470.

B. Material Compatibility: Roofing materials to be compatible with one another and adjacent materials under conditions of service and application required, as demonstrated by roof membrane manufacturer based on testing and field experience.

C. Wind Uplift Resistance: Design roofing system to resist the following wind uplift pressures, or to comply with the Fire/Windstorm Classification indicated in the following Paragraph, whichever is greater, when tested according to FM Approvals 4474, UL 580, or UL 1897:

1. Zone 1 (Roof Area Field): As indicated on Drawings.
2. Zone 2 (Roof Area Perimeter): As indicated on Drawings.

a. Location: From roof edge to dimension indicated on Drawing inside roof edge.

3. Zone 3 (Roof Area Corners): As indicated on Drawings.

a. Location: dimension indicated on Drawings in each direction from building corner.

D. FM Approvals' RoofNav Listing: Roof membrane, base flashings, and component materials comply with requirements in FM Approvals 4450 or FM Approvals 4470 as part of a roofing

system, and are listed in FM Approvals' RoofNav for Class 1 or noncombustible construction, as applicable. Identify materials with FM Approvals Certification markings.

1. Fire/Windstorm Classification: As determined based on wind uplift loads indicated on drawings except that securement of the first layer of insulation over metal deck to comply with requirements for Class 1A-120.
2. Hail-Resistance Rating: FM Global Property Loss Prevention Data Sheet 1-34 MH.

E. Solar Reflectance Index (SRI): Three-year-aged SRI not less than 64 or initial SRI not less than 82 when calculated according to ASTM E 1980, based on testing identical products by a qualified testing agency.

F. Exterior Fire-Test Exposure: ASTM E108 or UL 790, Class A; for application and roof slopes indicated; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

G. Fire-Resistance Ratings: Comply with fire-resistance-rated assembly designs indicated. Identify products with appropriate markings of applicable testing agency.

2.2 POLYVINYL CHLORIDE (PVC) ROOFING SYSTEM

A. PVC Sheet Type II: ASTM D4434/D4434M, glass-fiber reinforced, felt backed.

1. Basis-of-Design Product: Subject to compliance with requirements, provide **Sika Sarnafil; Sarnafil G410** or a comparable product by one of the following:

    a. Soprema, Inc.

2. Thickness: 60 mils.
3. Exposed Face Color: Reflective Gray.
4. Recycled Content: Provide products with postconsumer recycled content plus one-half of preconsumer recycled content to the extent required to comply with the minimum criteria specified in Section 01 81 13.14 “Sustainable Design Requirements.”

B. Source Limitations: Obtain components for roofing system from roof membrane manufacturer or manufacturers approved by roof membrane manufacturer.

2.3 ACCESSORY ROOFING MATERIALS

A. General: Accessory materials recommended by roofing system manufacturer for intended use and compatible with other roofing components.

1. Adhesives and Sealants: Comply with VOC limits of authorities having jurisdiction.
2. Verify adhesives and sealants comply with the following limits for VOC content:

    a. Plastic Foam Adhesives: 50 g/L.
    b. Gypsum Board and Panel Adhesives: 50 g/L.
    c. Multipurpose Construction Adhesives: 70 g/L.
    d. Fiberglass Adhesives: 80 g/L.
    e. Contact Adhesives: 80 g/L.
    f. PVC Welding Compounds: 510 g/L.

g. Other Adhesives: 250 g/L.
h. Single-Ply Roof Membrane Sealants: 450 g/L.
i. Nonmembrane Roof Sealants: 300 g/L.
j. Sealant Primers for Nonporous Substrates: 250 g/L.
k. Sealant Primers for Porous Substrates: 775 g/L.

3. Verify adhesives and sealants comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

B. Sheet Flashing: Manufacturer's standard sheet flashing of same material, type, reinforcement, thickness, and color as PVC sheet.

C. Prefabricated Pipe Flashings: As recommended by roof membrane manufacturer.

D. Bonding Adhesive: Manufacturer's standard.

E. Low-Rise, Urethane, Fabric-Backed Membrane Adhesive: Roof system manufacturer's standard spray-applied, low-rise, two-component urethane adhesive formulated for compatibility and use with fabric-backed membrane roofing.

F. Metal Termination Bars: Manufacturer's standard, predrilled stainless steel or aluminum bars, approximately 1 by 1/8 inch thick; with anchors.

G. Metal Battens: Manufacturer's standard, aluminum-zinc-alloy-coated or zinc-coated steel sheet, approximately 1 inch wide by 0.05 inch thick, prepunched.

H. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening roofing components to substrate, and acceptable to roofing system manufacturer.

I. Miscellaneous Accessories: Provide pourable sealers, preformed cone and vent sheet flashings, preformed inside and outside corner sheet flashings, T-joint covers, lap sealants, termination reglets, and other accessories.

2.4 SUBSTRATE BOARD

A. Gypsum Board, Type X: ASTM C1396/C1396M.

1. Thickness: 5/8 inch.

B. Glass-Mat Gypsum Roof Substrate Board: ASTM C1177/C1177M, water-resistant gypsum board.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to the following:

a. Georgia-Pacific Gypsum LLC; Dens Deck.
b. USG Corporation; Securock Glass Mat Roof Board.

2. Thickness: Type X, 5/8 inch.

3. Surface Finish: Unprimed.

C. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening substrate board to roof deck.

2.5 VAPOR RETARDER

A. Rubberized-Asphalt-Sheet Vapor Retarder, Self-Adhering: ASTM D1970/D1970M, polyethylene film laminated to layer of rubberized asphalt adhesive, minimum 30-mil total thickness; maximum permeance rating of 0.1 perm; cold applied, with slip-resisting surface and release paper backing. Provide primer when recommended by vapor retarder manufacturer.

2.6 ROOF INSULATION

A. General: Preformed roof insulation boards manufactured or approved by PVC roof membrane manufacturer, approved for use in FM Approvals' RoofNav listed roof assemblies.

B. Polyisocyanurate Board Insulation: ASTM C1289, Type II, Class 1, Grade 2, felt or glass-fiber mat facer on both major surfaces.

1. Compressive Strength: 20 psi.
2. Size: 48 by 48 inches.
3. Thickness:

    a. Base Layer: 2.6 inches.
    b. Upper Layer: 2.6 inches minimum.

C. Tapered Insulation: Provide factory-tapered insulation boards.

1. Material: Match roof insulation.
2. Minimum Thickness: 1/4 inch.
3. Slope:

    a. Roof Field: 1/4 inch per foot unless otherwise indicated on Drawings.
    b. Saddles and Crickets: 1/2 inch per foot unless otherwise indicated on Drawings.

2.7 INSULATION ACCESSORIES AND COVER BOARD

A. General: Roof insulation accessories recommended by insulation manufacturer for intended use and compatibility with other roofing system components.

B. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening roof insulation to substrate, and acceptable to roofing system manufacturer.

C. Insulation Adhesive: Insulation manufacturer's recommended adhesive formulated to attach roof insulation to substrate or to another insulation layer as follows:

1. Full-spread, spray-applied, low-rise, two-component urethane adhesive.

2. Verify adhesives and sealants comply with the following limits for VOC content:

    a. Plastic Foam Adhesives: 50 g/L.
    b. Gypsum Board and Panel Adhesives: 50 g/L.
    c. Multipurpose Construction Adhesives: 70 g/L.
    d. Fiberglass Adhesives: 80 g/L.
    e. Contact Adhesives: 80 g/L.
    f. PVC Welding Compounds: 510 g/L.
    g. Other Adhesives: 250 g/L.
    h. Single-Ply Roof Membrane Sealants: 450 g/L.
    i. Nonmembrane Roof Sealants: 300 g/L.
    j. Sealant Primers for Nonporous Substrates: 250 g/L.
    k. Sealant Primers for Porous Substrates: 775 g/L.

3. Verify adhesives and sealants comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

D. Glass-Mat Gypsum Cover Board: ASTM C1177/C1177M, water-resistant gypsum board.

1. Products: Subject to compliance with requirements, provide one of the following:

    a. Certainteed; SAINT-GOBAIN; GlasRoc Roof Board.
    b. Georgia-Pacific Gypsum LLC; Dens Deck Prime.
    c. USG Corporation; Securock Glass Mat Roof Board.

2. Thickness: 1/2 inch.
3. Surface Finish: Factory primed.

2.8 ELECTRONIC LEAK DETECTION (ELD) MATERIALS

A. Conductive Medium: Materials providing less than 10^4 ohms per square as determined in accordance with ASTM D4496 and approved by roof membrane manufacturer.

1. Electrically Conductive Primer: Water-based, non-flammable, nonmetallic, low-VOC primer, UL listed and FM Global approved.

    a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to the following:

        1) Detec Systems; TruGround.

2.9 WALKWAYS

A. Flexible Walkways: Factory-formed, nonporous, heavy-duty, slip-resisting, surface-textured walkway pads or rolls, approximately 3/16-inch-thick and acceptable to roofing system manufacturer.

1. Size: Approximately 36 by 60 inches.
2. Color: Match roof membrane.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.

1. Verify that roof openings and penetrations are in place, curbs are set and braced, and roof-drain bodies are securely clamped in place.
2. Verify that wood blocking, curbs, and nailers are securely anchored to roof deck at penetrations and terminations and that nailers match thicknesses of insulation.
3. Verify that surface plane flatness and fastening of steel roof deck complies with requirements in Section 053100 "Steel Decking."
4. Verify that minimum concrete drying period recommended by roofing system manufacturer has passed.
5. Verify that concrete substrate is visibly dry and free of moisture, and that minimum concrete internal relative humidity is not more than 75 percent, or as recommended by roofing system manufacturer, when tested according to ASTM F2170.

    a. Test Frequency: One test probe per each 1000 sq. ft., or portion thereof, of roof deck, with no fewer than three test probes.
    b. Submit test reports within 24 hours of performing tests.

6. Verify that concrete-curing compounds that will impair adhesion of roofing components to roof deck have been removed.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean substrate of dust, debris, moisture, and other substances detrimental to roofing system installation according to roofing system manufacturer's written instructions. Remove sharp projections.

B. Prevent materials from entering and clogging roof drains and conductors and from spilling or migrating onto surfaces of other construction. Remove roof-drain plugs when no work is taking place or when rain is forecast.

3.3 INSTALLATION OF ROOFING, GENERAL

A. Install roofing system according to roofing system manufacturer's written instructions, FM Approvals' RoofNav listed roof assembly requirements, and FM Global Property Loss Prevention Data Sheet 1-29.

B. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing system at end of workday or when rain is forecast. Remove and discard temporary seals before beginning work on adjoining roofing.

C. Coordinate installation and transition of roofing system component serving as an air barrier with air barrier specified under Section 072713 "Modified Bituminous Sheet Air Barriers."

3.4 INSTALLATION OF SUBSTRATE BOARD

A. Install substrate board with long joints in continuous straight lines, with end joints staggered not less than 24 inches in adjacent rows.

1. At steel roof decks, install substrate board at right angle to flutes of deck.

a. Locate end joints over crests of steel roof deck.

2. Tightly butt substrate boards together.
3. Cut substrate board to fit tight around penetrations and projections, and to fit tight to intersecting sloping roof decks.
4. Fasten substrate board to top flanges of steel deck according to recommendations in FM Approvals' RoofNav listed roof assembly requirements for specified Windstorm Resistance Classification and FM Global Property Loss Prevention Data Sheet 1-29.

3.5 INSTALLATION OF VAPOR RETARDER

A. Self-Adhering-Sheet Vapor Retarder: Prime substrate if required by manufacturer. Install self-adhering-sheet vapor retarder over area to receive vapor retarder, side and end lapping each sheet a minimum of 3-1/2 and 6 inches, respectively.

1. Extend vertically up parapet walls and projections to a minimum height equal to height of insulation and cover board.
2. Seal laps by rolling.

B. Completely seal vapor retarder at terminations, obstructions, and penetrations to prevent air movement into roofing system.

3.6 INSTALLATION OF INSULATION

A. Coordinate installing roofing system components so insulation is not exposed to precipitation or left exposed at end of workday.

B. Comply with roofing system and insulation manufacturer's written instructions for installing roof insulation.

C. Installation Over Metal Decking:

1. Install base layer of insulation with joints staggered not less than 24 inches in adjacent rows.

a. Locate end joints over crests of decking.
b. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
c. Make joints between adjacent insulation boards not more than 1/4 inch in width.
d. At internal roof drains, slope insulation to create a square drain sump with each side equal to the diameter of the drain bowl plus 24 inches.

1) Trim insulation so that water flow is unrestricted.

e. Fill gaps exceeding 1/4 inch with insulation.
f. Cut and fit insulation within 1/4 inch of nailers, projections, and penetrations.
g. Mechanically attach base layer of insulation and substrate board using mechanical fasteners specifically designed and sized for fastening specified board-type roof insulation to metal decks.

1) Fasten insulation according to requirements in FM Approvals' RoofNav for specified Windstorm Resistance Classification.

2. Install upper layers of insulation and tapered insulation with joints of each layer offset not less than 12 inches from previous layer of insulation.

a. Staggered end joints within each layer not less than 24 inches in adjacent rows.
b. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
c. Make joints between adjacent insulation boards not more than 1/4 inch in width.
d. At internal roof drains, slope insulation to create a square drain sump with each side equal to the diameter of the drain bowl plus 24 inches.
e. Trim insulation so that water flow is unrestricted.
f. Fill gaps exceeding 1/4 inch with insulation.
g. Cut and fit insulation within 1/4 inch of nailers, projections, and penetrations.
h. Adhere each layer of insulation to substrate using adhesive according to FM Approvals' RoofNav listed roof assembly requirements for specified Windstorm Resistance Classification and FM Global Property Loss Prevention Data Sheet 1-29, as follows:

1) Set each layer of insulation in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.

D. Installation Over Concrete Decks:

1. Install base layer of insulation with joints staggered not less than 24 inches in adjacent rows.

a. Make joints between adjacent insulation boards not more than 1/4 inch in width.
b. At internal roof drains, slope insulation to create a square drain sump with each side equal to the diameter of the drain bowl plus 24 inches.

1) Trim insulation so that water flow is unrestricted.

c. Fill gaps exceeding 1/4 inch with insulation.
d. Cut and fit insulation within 1/4 inch of nailers, projections, and penetrations.
e. Adhere base layer of insulation to vapor retarder according to FM Approvals' RoofNav listed roof assembly requirements for specified Windstorm Resistance Classification and FM Global Property Loss Prevention Data Sheet 1-29, as follows:

1) Set insulation in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.

2. Install upper layers of insulation and tapered insulation with joints of each layer offset not less than 12 inches from previous layer of insulation.

a. Staggered end joints within each layer not less than 24 inches in adjacent rows.
b. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
c. Make joints between adjacent insulation boards not more than 1/4 inch in width.
d. At internal roof drains, slope insulation to create a square drain sump with each side equal to the diameter of the drain bowl plus 24 inches.

1) Trim insulation so that water flow is unrestricted.

e. Fill gaps exceeding 1/4 inch with insulation.
f. Cut and fit insulation within 1/4 inch of nailers, projections, and penetrations.
g. Adhere each layer of insulation to substrate using adhesive according to FM Approvals' RoofNav listed roof assembly requirements for specified Windstorm Resistance Classification and FM Global Property Loss Prevention Data Sheet 1-29, as follows:

1) Set each layer of insulation in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.

E. Place plates on insulation in required fastening patterns to achieve FM rating and secure in accordance with manufacturer’s instructions.

1. Install plates and fasteners tight and flat to substrate with no dimpling, and with fastener extending 1 inch minimum into roof deck; do not overdrive fasteners.

3.7 INSTALLATION OF COVER BOARDS

A. Install cover boards over insulation with long joints in continuous straight lines with end joints staggered between rows. Offset joints of insulation below a minimum of 6 inches in each direction.

1. Trim cover board neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
2. At internal roof drains, conform to slope of drain sump.

a. Trim cover board so that water flow is unrestricted.

3. Cut and fit cover board tight to nailers, projections, and penetrations.
4. Adhere cover board to substrate using adhesive according to FM Approvals' RoofNav listed roof assembly requirements for specified Windstorm Resistance Classification and FM Global Property Loss Prevention Data Sheet 1-29, as follows:

a. Set cover board in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.

3.8 INSTALLATION OF ELD COMPONENTS

A. Install conductive medium over cover board in accordance with manufacturer's written instructions.

3.9 INSTALLATION OF ADHERED ROOF MEMBRANE

A. Adhere roof membrane over area to receive roofing according to roofing system manufacturer's written instructions.

B. Unroll roof membrane and allow to relax before installing.

C. Start installation of roofing in presence of roofing system manufacturer's technical personnel.

D. Accurately align roof membrane, and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.

E. Fabric-Backed Roof Membrane Adhesive: Apply to substrate at rate required by manufacturer, and install fabric-backed roof membrane.

F. In addition to adhering, mechanically fasten roof membrane securely at terminations, penetrations, and perimeter of roofing.

G. Apply roof membrane with side laps shingled with slope of roof deck where possible.

H. Seams: Clean seam areas, overlap roofing, and hot-air weld side and end laps of roof membrane and sheet flashings to ensure a watertight seam installation.

1. Test lap edges with probe to verify seam weld continuity. Apply lap sealant to seal cut edges of roof membrane and sheet flashings.
2. Verify field strength of seams a minimum of twice daily, and repair seam sample areas.
3. Repair tears, voids, and lapped seams in roof membrane that do not comply with requirements.

I. Spread sealant bed over deck-drain flange at roof drains, and securely seal roof membrane in place with clamping ring.

3.10 INSTALLATION OF BASE FLASHING

A. Install sheet flashings and preformed flashing accessories, and adhere to substrates according to roofing system manufacturer's written instructions.

B. Apply bonding adhesive to substrate and underside of sheet flashing at required rate, and allow to partially dry. Do not apply to seam area of flashing.

C. Flash penetrations and field-formed inside and outside corners with cured or uncured sheet flashing.

D. Clean seam areas, overlap, and firmly roll sheet flashings into the adhesive. Hot-air weld side and end laps to ensure a watertight seam installation.

E. Terminate and seal top of sheet flashings and mechanically anchor to substrate through termination bars.

3.11 INSTALLATION OF WALKWAYS

A. Flexible Walkways: Install walkway products according to manufacturer's written instructions.

1. Install flexible walkways at the following locations:

a. Locations indicated on Drawings.
b. Perimeter of each rooftop unit.
c. Between each rooftop unit location, creating a continuous path connecting rooftop unit locations.
d. Between each roof hatch and each rooftop unit location or path connecting rooftop unit locations.
e. Top and bottom of each roof access ladder.
f. Between each roof access ladder and each rooftop unit location or path connecting rooftop unit locations.
g. As required by roof membrane manufacturer's warranty requirements.

2. Provide 6-inch clearance between adjoining pads.
3. Heat weld to substrate or adhere walkway products to substrate with compatible adhesive according to roofing system manufacturer's written instructions.

3.12 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to inspect substrate conditions, surface preparation, roof membrane application, sheet flashings, protection, and drainage components, and to furnish reports to Architect.

B. Perform the following tests:

1. Infrared Thermography: Testing agency surveys entire roof area using infrared color thermography according to ASTM C1153.

a. Perform tests before overlying construction is placed.
b. After infrared scan, locate specific areas of leaks by electrical capacitance/impedance testing or nuclear hydrogen detection tests.
c. After testing, repair leaks, repeat tests, and make further repairs until roofing and flashing installations are watertight.

1) Cost of retesting is Contractor's responsibility.

d. Testing agency to prepare survey report of initial scan indicating locations of entrapped moisture, if any.

2. Low-Voltage ELD Testing: Testing agency surveys entire roof area and flashings to locate discontinuities in the roof membrane using low-voltage horizontal membrane scanning platform in accordance with ASTM D8231.

a. Perform tests before overlying construction is placed.
b. After testing, repair areas of discontinuities, repeat tests, and make further repairs until roofing and flashing installations are contiguous.

1) Cost of retesting is Contractor's responsibility.

c. Testing agency to prepare survey report indicating locations of initial discontinuities, if any.

3.13 PROTECTING AND CLEANING

A. Protect roofing system from damage and wear during remainder of construction period. When remaining construction does not affect or endanger roofing, inspect roofing system for deterioration and damage, describing its nature and extent in a written report, with copies to Architect and Owner.

B. Correct deficiencies in or remove roofing system that does not comply with requirements, repair substrates, and repair or reinstall roofing system to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.

C. Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

3.14 ROOFING INSTALLER'S WARRANTY

A. WHEREAS _____ of _____, herein called the "Roofing Installer," has performed roofing and associated work ("work") on the following project:

1. Owner: <**Insert name of Owner**>.
2. Owner Address: <**Insert address**>.
3. Building Name/Type: <**Insert information**>.
4. Building Address: <**Insert address**>.
5. Area of Work: <**Insert information**>.
6. Acceptance Date: _____.
7. Warranty Period: 25 years from Substantial Completion of Project.
8. Expiration Date: _____.

B. AND WHEREAS Roofing Installer has contracted (either directly with Owner or indirectly as a subcontractor) to warrant said work against leaks and faulty or defective materials and workmanship for designated Warranty Period,

C. NOW THEREFORE Roofing Installer hereby warrants, subject to terms and conditions herein set forth, that during Warranty Period Roofing Installer will, at Roofing Installer's own cost and expense, make or cause to be made such repairs to or replacements of said work as are necessary to correct faulty and defective work and as are necessary to maintain said work in a watertight condition.

D. This Warranty is made subject to the following terms and conditions:

1. Specifically excluded from this Warranty are damages to work and other parts of the building, and to building contents, caused by:

a. lightning;
b. peak gust wind speed exceeding <**Insert mph**>;
c. fire;

d. failure of roofing system substrate, including cracking, settlement, excessive deflection, deterioration, and decomposition;
e. faulty construction of parapet walls, copings, chimneys, skylights, vents, equipment supports, and other edge conditions and penetrations of the work;
f. vapor condensation on bottom of roofing; and
g. activity on roofing by others, including construction contractors, maintenance personnel, other persons, and animals, whether authorized or unauthorized by Owner.

2. When work has been damaged by any of foregoing causes, Warranty shall be null and void until such damage has been repaired by Roofing Installer and until cost and expense thereof have been paid by Owner or by another responsible party so designated.
3. Roofing Installer is responsible for damage to work covered by this Warranty but is not liable for consequential damages to building or building contents resulting from leaks or faults or defects of work.
4. During Warranty Period, if Owner allows alteration of work by anyone other than Roofing Installer, including cutting, patching, and maintenance in connection with penetrations, attachment of other work, and positioning of anything on roof, this Warranty shall become null and void on date of said alterations, but only to the extent said alterations affect work covered by this Warranty. If Owner engages Roofing Installer to perform said alterations, Warranty shall not become null and void unless Roofing Installer, before starting said work, shall have notified Owner in writing, showing reasonable cause for claim, that said alterations would likely damage or deteriorate work, thereby reasonably justifying a limitation or termination of this Warranty.
5. During Warranty Period, if original use of roof is changed and it becomes used for, but was not originally specified for, a promenade, work deck, spray-cooled surface, flooded basin, or other use or service more severe than originally specified, this Warranty shall become null and void on date of said change, but only to the extent said change affects work covered by this Warranty.
6. Owner shall promptly notify Roofing Installer of observed, known, or suspected leaks, defects, or deterioration and shall afford reasonable opportunity for Roofing Installer to inspect work and to examine evidence of such leaks, defects, or deterioration.
7. This Warranty is recognized to be the only warranty of Roofing Installer on said work and shall not operate to restrict or cut off Owner from other remedies and resources lawfully available to Owner in cases of roofing failure. Specifically, this Warranty shall not operate to relieve Roofing Installer of responsibility for performance of original work according to requirements of the Contract Documents, regardless of whether Contract was a contract directly with Owner or a subcontract with Owner's General Contractor.

E. IN WITNESS THEREOF, this instrument has been duly executed this _____ day of _____, _____.

1. Authorized Signature: _____.
2. Name: _____.
3. Title: _____.

END OF SECTION

SECTION 07 62 00 - SHEET METAL FLASHING AND TRIM

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Roof-drainage sheet metal fabrications.
2. Low-slope roof sheet metal fabrications.
3. Wall sheet metal fabrications.

B. Related Requirements:

1. Section 061000 "Rough Carpentry" for wood nailers, curbs, and blocking.
2. Section 077200 "Roof Accessories" for set-on-type curbs, equipment supports, roof hatches, vents, and other manufactured roof accessory units.

1.2 COORDINATION

A. Coordinate sheet metal flashing and trim layout and seams with sizes and locations of penetrations to be flashed, and joints and seams in adjacent materials.

B. Coordinate sheet metal flashing and trim installation with adjoining roofing and wall materials, joints, and seams to provide leakproof, secure, and noncorrosive installation.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review construction schedule. Verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
2. Review special roof details, roof drainage, roof-penetration flashing, equipment curbs, and condition of other construction that affect sheet metal flashing and trim.
3. Review requirements for insurance and certificates if applicable.
4. Review sheet metal flashing observation and repair procedures after flashing installation.

1.4 ACTION SUBMITTALS

A. Product Data: For each of the following

1. Underlayment materials.
2. Elastomeric sealant.
3. Butyl sealant.

B. Sustainable Design Submittals:

1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.

C. Shop Drawings: For sheet metal flashing and trim.

1. Include plans, elevations, sections, and attachment details.
2. Detail fabrication and installation layouts, expansion-joint locations, and keyed details. Distinguish between shop- and field-assembled Work.
3. Include identification of material, thickness, weight, and finish for each item and location in Project.
4. Include details for forming, including profiles, shapes, seams, and dimensions.
5. Include details for joining, supporting, and securing, including layout and spacing of fasteners, cleats, clips, and other attachments. Include pattern of seams.
6. Include details of termination points and assemblies.
7. Include details of expansion joints and expansion-joint covers, including showing direction of expansion and contraction from fixed points.
8. Include details of roof-penetration flashing.
9. Include details of edge conditions, including flashings and counterflashings.
10. Include details of special conditions.
11. Include details of connections to adjoining work.
12. Detail formed flashing and trim at scale of not less than 3 inches per 12 inches.

D. Samples for Verification: For each type of exposed finish.

1. Sheet Metal Flashing: 12 inches long by actual width of unit, including finished seam and in required profile. Include fasteners, cleats, clips, closures, and other attachments.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For fabricator.

B. Product Certificates: For each type of coping and roof edge flashing that is ANSI/SPRI/FM 4435/ES-1 tested and FM Approvals approved.

C. Product Test Reports: For each product, for tests performed by a qualified testing agency.

D. Evaluation Reports: For copings and roof edge flashing, from an agency acceptable to authority having jurisdiction showing compliance with ANSI/SPRI/FM 4435/ES-1.

E. Sample Warranty: For special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For sheet metal flashing and trim, and its accessories, to include in maintenance manuals.

B. Special warranty.

1.7 QUALITY ASSURANCE

A. Fabricator Qualifications: Employs skilled workers who custom fabricate sheet metal flashing and trim similar to that required for this Project and whose products have a record of successful in-service performance.

1. For copings and roof edge flashings that are ANSI/SPRI/FM 4435/ES-1 tested and FM Approvals approved, shop is to be listed as able to fabricate required details as tested and approved.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Do not store sheet metal flashing and trim materials in contact with other materials that might cause staining, denting, or other surface damage.

1. Store sheet metal flashing and trim materials away from uncured concrete and masonry.
2. Protect stored sheet metal flashing and trim from contact with water.

B. Protect strippable protective covering on sheet metal flashing and trim from exposure to sunlight and high humidity, except to extent necessary for period of sheet metal flashing and trim installation.

1.9 WARRANTY

A. Special Warranty on Finishes: Manufacturer agrees to repair finish or replace sheet metal flashing and trim that shows evidence of deterioration of factory-applied finishes within specified warranty period.

1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:

a. Color fading more than 5 Delta E units when tested in accordance with ASTM D2244.
b. Chalking in excess of a No. 8 rating when tested in accordance with ASTM D4214.
c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Sheet metal flashing and trim assemblies, including cleats, anchors, and fasteners, are to withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Completed sheet metal flashing and trim are not to rattle, leak, or loosen, and are to remain watertight.

B. Sheet Metal Standard for Flashing and Trim: Comply with NRCA's "The NRCA Roofing Manual: Architectural Metal Flashing, Condensation and Air Leakage Control, and Reroofing" and

SMACNA's "Architectural Sheet Metal Manual" requirements for dimensions and profiles shown unless more stringent requirements are indicated.

C. SPRI Wind Design Standard: Manufacture and install copings and roof edge flashings tested in accordance with ANSI/SPRI/FM 4435/ES-1 and capable of resisting the following design pressure:

1. Design Pressure: As indicated on Drawings.

D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes to prevent buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

2.2 SHEET METALS

A. Protect mechanical and other finishes on exposed surfaces from damage by applying strippable, temporary protective film before shipping.

B. Aluminum Sheet: ASTM B209, alloy as standard with manufacturer for finish required, with temper as required to suit forming operations and performance required; with smooth, flat surface.

1. Recycled Content: Provide products with postconsumer recycled content plus one-half of preconsumer recycled content to the extent required to comply with the minimum criteria specified in Section 01 81 13.14 “Sustainable Design Requirements.”

2. Exposed Coil-Coated Finish:

a. Two-Coat Fluoropolymer: AAMA 2605. Fluoropolymer finish containing not less than 70 percent polyvinylidene fluoride (PVDF) resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

3. Color: As preselected and indicated in Finish Schedule.
4. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with minimum total dry film thickness of 0.5 mil.

C. Stainless Steel Sheet: ASTM A240/A240M, Type 316, dead soft, fully annealed; with smooth, flat surface.

1. Recycled Content: Provide products with postconsumer recycled content plus one-half of preconsumer recycled content to the extent required to comply with the minimum criteria specified in Section 01 81 13.14 “Sustainable Design Requirements.”
2. Finish: ASTM A480/A480M, No. 2D (dull, cold rolled).

a. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.

2.3 UNDERLAYMENT MATERIALS

A. Self-Adhering, High-Temperature Sheet Underlayment: Minimum 30 mils thick, consisting of a slip-resistant polyethylene- or polypropylene-film top surface laminated to a layer of butyl- or SBS-modified asphalt adhesive, with release-paper backing; specifically designed to withstand high metal temperatures beneath metal roofing. Provide primer in accordance with underlayment manufacturer's written instructions.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Carlisle WIP Products; a brand of Carlisle Construction Materials.
b. GCP Applied Technologies Inc.
c. Henry Company.

2. Source Limitations: Obtain underlayment from single source from single manufacturer.
3. Low-Temperature Flexibility: ASTM D1970/D1970M; passes after testing at minus 20 deg F or lower.

2.4 MISCELLANEOUS MATERIALS

A. Provide materials and types of fasteners, solder, protective coatings, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation and as recommended by manufacturer of primary sheet metal or manufactured item unless otherwise indicated.

B. Fasteners: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads and recommended by manufacturer of primary sheet metal or manufactured item.

1. General: Blind fasteners or self-drilling screws, gasketed, with hex-washer head.

a. Exposed Fasteners: Heads matching color of sheet metal using plastic caps or factory-applied coating. Provide metal-backed EPDM or PVC sealing washers under heads of exposed fasteners bearing on weather side of metal.
b. Blind Fasteners: High-strength aluminum or stainless steel rivets suitable for metal being fastened.

2. Fasteners for Aluminum Sheet: Aluminum or Series 300 stainless steel.
3. Fasteners for Stainless Steel Sheet: Series 300 stainless steel.

C. Solder:

1. For Stainless Steel: ASTM B32, Grade Sn96, with acid flux of type recommended by stainless steel sheet manufacturer.

D. Sealant Tape: Pressure-sensitive, 100 percent solids, polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch wide and 1/8 inch thick.

E. Elastomeric Sealant: ASTM C920, elastomeric polyurethane polymer sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.

F. Butyl Sealant: ASTM C1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for hooked-type expansion joints with limited movement.

G. Bituminous Coating: Cold-applied asphalt emulsion in accordance with ASTM D1187/D1187M.

H. Reglets: Units of type, material, and profile required, formed to provide secure interlocking of separate reglet and counterflashing pieces, and compatible with flashing indicated with factory-mitered and -welded corners and junctions and with interlocking counterflashing on exterior face, of same metal as reglet.

1. Basis-of-Design Product: Subject to compliance with requirements, provide **Fry Reglet Corporation; Springlok** or a comparable product by one of the following:

    a. Cheney Flashing Company.
    b. Heckmann Building Products, Inc.
    c. Hohmann & Barnard, Inc.
    d. Keystone Flashing Company, Inc.
    e. Metal-Era, Inc.
    f. OMG Roofing Products; a Division of OMG, Inc., a subsidiary of Steel Partners Holdings L.P.

2. Source Limitations: Obtain reglets from single source from single manufacturer.
3. Material: Stainless steel, 0.0188 inch thick Aluminum, 0.024 inch thick.

2.5 FABRICATION, GENERAL

A. Custom fabricate sheet metal flashing and trim to comply with details indicated and recommendations in cited sheet metal standard that apply to design, dimensions, geometry, metal thickness, and other characteristics of item required.

1. Fabricate sheet metal flashing and trim in shop to greatest extent possible.
2. Fabricate sheet metal flashing and trim in thickness or weight needed to comply with performance requirements, but not less than that specified for each application and metal.
3. Verify shapes and dimensions of surfaces to be covered and obtain field measurements for accurate fit before shop fabrication.
4. Form sheet metal flashing and trim to fit substrates without excessive oil-canning, buckling, and tool marks; true to line, levels, and slopes; and with exposed edges folded back to form hems.
5. Conceal fasteners and expansion provisions where possible. Do not use exposed fasteners on faces exposed to view.

B. Fabrication Tolerances:

1. Fabricate sheet metal flashing and trim that is capable of installation to a tolerance of 1/4 inch in 20 feet on slope and location lines indicated on Drawings and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

C. Expansion Provisions: Form metal for thermal expansion of exposed flashing and trim.

1. Form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with butyl sealant concealed within joints.

D. Sealant Joints: Where movable, nonexpansion-type joints are required, form metal in accordance with cited sheet metal standard to provide for proper installation of elastomeric sealant.

E. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.

F. Fabricate cleats and attachment devices of sizes as recommended by cited sheet metal standard for application, but not less than thickness of metal being secured.

G. Seams:

1. For stainless steel, fabricate nonmoving seams with flat-lock seams. Tin edges to be seamed, form seams, and solder.
2. For prefinished aluminum, fabricate nonmoving seams with flat-lock seams. Form seams and seal with elastomeric sealant unless otherwise recommended by sealant manufacturer for intended use. Rivet joints where necessary for strength.

H. Do not use graphite pencils to mark metal surfaces.

2.6 LOW-SLOPE ROOF SHEET METAL FABRICATIONS

A. Roof Edge Flashing (Gravel Stop) and Fascia Cap: Fabricate in minimum 96-inch-long, but not exceeding 12-foot-long sections. Furnish with 6-inch-wide, joint cover plates. Shop fabricate interior and exterior corners.

1. Joint Style: Butted with expansion space and 6-inch-wide, concealed backup plate.
2. Fabricate with scuppers spaced 10 feet apart, to dimensions required with 4-inch-wide flanges and base extending 4 inches beyond cant or tapered strip into field of roof. Fasten gravel guard angles to base of scupper.
3. Fabricate from the following materials:

a. Aluminum: 0.050 inch thick.

B. Copings: Fabricate in minimum 96-inch-long, but not exceeding 12-foot-long, sections. Fabricate joint plates of same thickness as copings. Furnish with continuous cleats to support edge of external leg and drill elongated holes for fasteners on interior leg. Miter corners, fasten and seal watertight. Shop fabricate interior and exterior corners.

1. Coping Profile: Unless indicated otherwise comply with Fig. 3-4A in accordance with SMACNA's "Architectural Sheet Metal Manual."
2. Joint Style: Butted with expansion space and 6-inch-wide, concealed backup plate.
3. Fabricate from the following materials:

a. Aluminum: 0.050 inch thick.

C. Base Flashing: Shop fabricate interior and exterior corners. Fabricate from the following materials:

1. Stainless Steel: 0.0188 inch thick.

D. Counterflashing: Shop fabricate interior and exterior corners. Fabricate from the following materials:

1. Stainless Steel: 0.0188 inch thick.

E. Flashing Receivers: Fabricate from the following materials:

1. Stainless Steel: 0.0156 inch thick.

F. Roof-Penetration Flashing: Fabricate from the following materials:

1. Stainless Steel: 0.0188 inch thick.

2.7 WALL SHEET METAL FABRICATIONS

A. Through-Wall Flashing: Fabricate continuous flashings in minimum 96-inch-long, but not exceeding 12-foot-long, sections, under copings, and at shelf angles. Fabricate discontinuous lintel, sill, and similar flashings to extend 6 inches beyond each side of wall openings; and form with 2-inch-high, end dams. Fabricate from the following materials:

1. Stainless Steel: 0.0156 inch thick.

B. Opening Flashings in Frame Construction: Fabricate head, sill, jamb, and similar flashings to extend 4 inches beyond wall openings. Form head and sill flashing with 2-inch-high, end dams. Fabricate from the following materials:

1. Aluminum: 0.032 inch thick.
2. Stainless Steel: 0.0156 inch thick.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with installer present, for compliance with requirements for installation tolerances, substrate, and other conditions affecting performance of the Work.

1. Verify compliance with requirements for installation tolerances of substrates.
2. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.
3. Verify that air- or water-resistant barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF UNDERLAYMENT

A. Self-Adhering, High-Temperature Sheet Underlayment:

1. Install self-adhering, high-temperature sheet underlayment; wrinkle free.
2. Prime substrate if recommended by underlayment manufacturer.
3. Comply with temperature restrictions of underlayment manufacturer for installation; use primer for installing underlayment at low temperatures.
4. Apply in shingle fashion to shed water, with end laps of not less than 6 inches staggered 24 inches between courses.
5. Overlap side edges not less than 3-1/2 inches. Roll laps and edges with roller.
6. Roll laps and edges with roller.
7. Cover underlayment within 14 days.

3.3 INSTALLATION, GENERAL

A. Install sheet metal flashing and trim to comply with details indicated and recommendations of cited sheet metal standard that apply to installation characteristics required unless otherwise indicated on Drawings.

1. Install fasteners, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.
2. Install sheet metal flashing and trim true to line, levels, and slopes. Provide uniform, neat seams with minimum exposure of sealant.
3. Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement.
4. Install sheet metal flashing and trim to fit substrates and to result in watertight performance.
5. Install continuous cleats with fasteners spaced not more than 12 inches o.c.
6. Install exposed sheet metal flashing and trim with limited oil-canning, and free of buckling and tool marks.
7. Do not field cut sheet metal flashing and trim by torch.
8. Do not use graphite pencils to mark metal surfaces.

B. Metal Protection: Where dissimilar metals contact each other, or where metal contacts pressure-treated wood or other corrosive substrates, protect against galvanic action or corrosion by painting contact surfaces with bituminous coating or by other permanent separation as recommended by sheet metal manufacturer or cited sheet metal standard.

1. Coat concealed side of stainless steel sheet metal flashing and trim with bituminous coating where flashing and trim contact wood, ferrous metal, or cementitious construction.
2. Underlayment: Where installing sheet metal flashing and trim directly on cementitious or wood substrates, install underlayment and cover with slip sheet.

C. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim.

1. Space movement joints at maximum of 10 feet with no joints within 24 inches of corner or intersection.

D. Fasteners: Use fastener sizes that penetrate substrate not less than recommended by fastener manufacturer to achieve maximum pull-out resistance.

E. Conceal fasteners and expansion provisions where possible in exposed work and locate to minimize possibility of leakage. Cover and seal fasteners and anchors as required for a tight installation.

F. Seal joints as required for watertight construction.

1. Use sealant-filled joints unless otherwise indicated.

a. Embed hooked flanges of joint members not less than 1 inch into sealant.
b. Form joints to completely conceal sealant.
c. When ambient temperature at time of installation is between 40 and 70 deg F, set joint members for 50 percent movement each way.
d. Adjust setting proportionately for installation at higher ambient temperatures.

1) Do not install sealant-type joints at temperatures below 40 deg F.

2. Prepare joints and apply sealants to comply with requirements in Section 079200 "Joint Sealants."

G. Soldered Joints: Clean surfaces to be soldered, removing oils and foreign matter.

1. Pretin edges of sheets with solder to width of 1-1/2 inches; however, reduce pretinning where pretinned surface would show in completed Work.
2. Do not solder aluminum sheet.
3. Do not use torches for soldering.
4. Heat surfaces to receive solder, and flow solder into joint.

a. Fill joint completely.
b. Completely remove flux and spatter from exposed surfaces.

5. Stainless Steel Soldering:

a. Tin edges of uncoated sheets, using solder for stainless steel and acid flux.
b. Promptly remove acid-flux residue from metal after tinning and soldering.
c. Comply with solder manufacturer's recommended methods for cleaning and neutralization.

3.4 INSTALLATION OF ROOF FLASHINGS

A. Install sheet metal flashing and trim to comply with performance requirements, sheet metal manufacturer's written installation instructions, and cited sheet metal standard.

1. Provide concealed fasteners where possible, and set units true to line, levels, and slopes.
2. Install work with laps, joints, and seams that are permanently watertight and weather resistant.

B. Roof Edge Flashing:

1. Install roof edge flashings in accordance with ANSI/SPRI/FM 4435/ES-1.
2. Anchor to resist uplift and outward forces in accordance with recommendations in FM Global Property Loss Prevention Data Sheet 1-49 for FM Approvals' listing for required windstorm classification.

C. Copings:

1. Install roof edge flashings in accordance with ANSI/SPRI/FM 4435/ES-1.
2. Anchor to resist uplift and outward forces in accordance with recommendations in FM Global Property Loss Prevention Data Sheet 1-49 for specified FM Approvals' listing for required windstorm classification.

D. Pipe or Post Counterflashing: Install counterflashing umbrella with close-fitting collar with top edge flared for elastomeric sealant, extending minimum of 4 inches over base flashing. Install stainless steel draw band and tighten.

E. Counterflashing: Coordinate installation of counterflashing with installation of base flashing.

1. Insert counterflashing in reglets or receivers and fit tightly to base flashing.
2. Extend counterflashing 4 inches over base flashing.
3. Lap counterflashing joints minimum of 4 inches.
4. Secure in waterproof manner by means of anchor and washer spaced at 12 inches o.c. along perimeter and 6 inches o.c. at corners areas unless otherwise indicated.

F. Roof-Penetration Flashing: Coordinate installation of roof-penetration flashing with installation of roofing and other items penetrating roof. Seal with elastomeric sealant and clamp flashing to pipes that penetrate roof.

3.5 INSTALLATION OF WALL FLASHINGS

A. Install sheet metal wall flashing to intercept and exclude penetrating moisture in accordance with cited sheet metal standard unless otherwise indicated. Coordinate installation of wall flashing with installation of wall-opening components such as windows, doors, and louvers.

B. Opening Flashings in Frame Construction: Install continuous head, sill, jamb, and similar flashings to extend 4 inches beyond wall openings.

3.6 INSTALLATION TOLERANCES

A. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerance of 1/4 inch in 20 feet on slope and location lines indicated on Drawings and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

3.7 CLEANING

A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.

B. Clean and neutralize flux materials. Clean off excess solder.

C. Clean off excess sealants.

3.8 PROTECTION

A. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed unless otherwise indicated in manufacturer's written installation instructions.

B. On completion of sheet metal flashing and trim installation, remove unused materials and clean finished surfaces as recommended in writing by sheet metal flashing and trim manufacturer.

C. Maintain sheet metal flashing and trim in clean condition during construction.

D. Replace sheet metal flashing and trim that have been damaged or that have deteriorated beyond successful repair by finish touchup or similar minor repair procedures, as determined by Architect.

END OF SECTION

SECTION 07 72 00 - ROOF ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Roof curbs.

1.2 COORDINATION

A. Coordinate layout and installation of roof accessories with roofing membrane and base flashing and interfacing and adjoining construction to provide a leakproof, weathertight, secure, and noncorrosive installation.

B. Coordinate dimensions with rough-in information or Shop Drawings of equipment to be supported.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of roof accessory.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Shop Drawings: For roof accessories.

1. Include plans, elevations, keyed details, and attachments to other work. Indicate dimensions, loadings, and special conditions. Distinguish between plant- and field-assembled work.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Roof plans, drawn to scale, and coordinating penetrations and roof-mounted items. Show the following:

1. Size and location of roof accessories specified in this Section.
2. Method of attaching roof accessories to roof or building structure.
3. Other roof-mounted items including mechanical and electrical equipment, ductwork, piping, and conduit.
4. Required clearances.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For roof accessories to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. General Performance: Roof accessories to withstand exposure to weather and resist thermally induced movement without failure, rattling, leaking, or fastener disengagement due to defective manufacture, fabrication, installation, or other defects in construction.

2.2 ROOF CURBS

A. Roof Curbs at Duct Penetrations: Internally reinforced roof-curb units capable of supporting superimposed live and dead loads and other construction indicated on Drawings, bearing continuously on roof, and capable of meeting performance requirements; with welded and sealed corner joints, straight sides, integral metal cant, and integrally formed deck-mounting flange at perimeter bottom.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Air Balance; MESTEK, Inc.; Model CAC - CSC or a comparable product by one of the following:

a. Greenheck Fan Corporation.
b. Roof Products and Systems (RPS); a division of Hart & Cooley, Inc.

B. Size: Coordinate dimensions with duct penetration information or Shop Drawings of equipment to be supported.

C. Supported Load Capacity: Coordinate load capacity with information on Shop Drawings of equipment to be supported.

D. Aluminum: 0.125 inch thick sheet.

1. Finish: Mill.

E. Construction:

1. Curb Profile: Manufacturer's standard compatible with roofing system.
2. Height: 8 inches
3. Insulation: Factory insulated with 1-inch-thick semi-rigid glass-fiber board insulation.
4. Nailer: Factory-installed wood nailer along top flange of curb, continuous around curb perimeter.

2.3 METAL MATERIALS

A. Aluminum Sheet: ASTM B209, manufacturer's standard alloy for finish required, with temper to suit forming operations and performance required.

1. Mill Finish: As manufactured.

B. Aluminum Extrusions and Tubes: ASTM B221, manufacturer's standard alloy and temper for type of use, finished to match assembly where used; otherwise mill finished.

2.4 MISCELLANEOUS MATERIALS

A. Provide materials and types of fasteners, protective coatings, sealants, and other miscellaneous items required by manufacturer for a complete installation.

B. Cellulosic-Fiber Board Insulation: ASTM C208, Type II, Grade 1, thickness as indicated.

C. Wood Nailers: Softwood lumber, pressure treated with waterborne preservatives for aboveground use, acceptable to authorities having jurisdiction, containing no arsenic or chromium, and complying with AWPA C2; not less than 1-1/2 inches thick.

D. Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D1187***/***D1187M.

E. Fasteners: Roof accessory manufacturer's recommended fasteners suitable for application and metals being fastened. Match finish of exposed fasteners with finish of material being fastened. Provide nonremovable fastener heads to exterior exposed fasteners. Furnish the following unless otherwise indicated:

1. Fasteners for Aluminum Sheet: Aluminum or Series 300 stainless steel.

F. Gaskets: Manufacturer's standard tubular or fingered design of neoprene, EPDM, PVC, or silicone or a flat design of foam rubber, sponge neoprene, or cork.

G. Elastomeric Sealant: ASTM C920, elastomeric polyurethane polymer sealant as recommended by roof accessory manufacturer for installation indicated; low modulus; of type, grade, class, and use classifications required to seal joints and remain watertight.

H. Butyl Sealant: ASTM C1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for expansion joints with limited movement.

2.5 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions, and other conditions affecting performance of the Work.

B. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.

C. Verify dimensions of roof openings for roof accessories.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install roof accessories according to manufacturer's written instructions.

1. Install roof accessories level; plumb; true to line and elevation; and without warping, jogs in alignment, buckling, or tool marks.
2. Anchor roof accessories securely in place so they are capable of resisting indicated loads.
3. Use fasteners, separators, sealants, and other miscellaneous items as required to complete installation of roof accessories and fit them to substrates.
4. Install roof accessories to resist exposure to weather without failing, rattling, leaking, or loosening of fasteners and seals.

B. Metal Protection: Protect metals against galvanic action by separating dissimilar metals from contact with each other or with corrosive substrates by painting contact surfaces with bituminous coating or by other permanent separation as recommended by manufacturer.

1. Coat concealed side of uncoated aluminum roof accessories with bituminous coating where in contact with wood, ferrous metal, or cementitious construction.
2. Underlayment: Where installing roof accessories directly on cementitious or wood substrates, install a course of underlayment and cover with manufacturer's recommended slip sheet.
3. Bed flanges in thick coat of asphalt roofing cement where required by manufacturers of roof accessories for waterproof performance.

C. Roof Curb Installation: Install each roof curb so top surface is level.

D. Seal joints as required by roof accessory manufacturer.

3.3 REPAIR AND CLEANING

A. Clean exposed surfaces according to manufacturer's written instructions.

B. Clean off excess sealants.

C. Replace roof accessories that have been damaged or that cannot be successfully repaired by finish touchup or similar minor repair procedures.

END OF SECTION

This page is intentionally left blank.

SECTION 07 72 73 - VEGETATED ROOF SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Continuous vegetated roof assembly.
2. Walkway pavers.

B. Related Requirements:

1. Section 07 14 13 "Hot Fluid-Applied Rubberized Asphalt Waterproofing" for roof waterproofing membrane, rigid board thermal insulation, and roofing system waterproofing warranty associated with vegetated roof system.

1.2 DEFINITIONS

A. Captured Water: Water that is retained in the drainage layer of a vegetated roof assembly after new water additions have ceased and that cannot escape the roof except through evaporation or plant transpiration.

B. Finish Elevation: Elevation of finished growing-media surface of planting area.

C. Growing Medium: Manufactured, lightweight soil mixture that promotes good growing conditions for specific varieties of plants.

D. Planting Area: Areas to be planted.

E. Plant; Plants; Plant Material: Vegetation in general, including trees, shrubs, vines, ground covers, ornamental grasses, bulbs, corms, tubers, or herbaceous vegetation.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each vegetated roof assembly.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
2. Include material descriptions for each growing medium.

B. Sustainable Design Submittals:

1. Native Planting, Action Submittals: Provide plant information indicating compliance with native and adapted planting requirements for rain gardens for rainwater management.
2. Vegetated Roof, Action Submittals: Provide manufacturer's cut sheets indicating compliance with vegetated roof requirements for rainwater management.

C. Shop Drawings: For each vegetated roof assembly.

1. Include plans, sections, slopes, and drain locations.
2. Indicate dimensions, weights, and loads.
3. Detail field assembly of components, depth of growing media, and attachments to other work.
4. Indicate walkway pavers, coordination with lighting, and accessories.

D. Samples for Verification: For each of the following components of vegetated roof assembly:

1. Preplanted Vegetative Mat: 12 by 12 inches.
2. Growing Media: 1-quart volume of each growing medium, in sealed plastic bags labeled with content and source. Each Sample to be typical of the lots of growing media to be furnished. Provide an accurate representation of texture and composition.
3. Separation and Root Barrier Protection Course: 12 by 12 inches.
4. Rock Mineral Wool Moisture-Retention Mat: 12 by 12 inches.
5. Air and Drainage Layer: 12 by 12 inches.
6. Walkway paver, full size, in each color and texture required; include installation accessories to illustrate assembly.
7. Filter Fabric: 12 by 12 inches.
8. Access Boxes: One in each size and color required.
9. Soil Retainer: Manufacturer's standard size to verify configuration and color selected.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer**.**

B. Installation Instructions: Manufacturer’s written installation instructions for vegetated roof system assembly.

C. Product Certificates: For each type of manufactured product.

1. Manufacturer's certified analysis of standard products.
2. Analysis of other materials by a recognized laboratory, in accordance with methods established by the Association of Official Analytical Chemists, where applicable.

D. Product Test Reports: For complete analysis of each growing medium, for tests performed by manufacturer and witnessed by a qualified testing agency or by a qualified testing agency.

E. Sample Warranty: For special warranties.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For vegetated roof assembly and plants, including a recommended maintenance plan with procedures for inspection and care during a calendar year. Submit before start of required warranty and maintenance periods.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: A qualified vegetated roof assembly Installer, approved, authorized, or licensed by roofing-membrane manufacturer, whose work has resulted in successful establishment of vegetated roofs.

1. Field Supervision: Require Installer to maintain an experienced full-time, English-speaking supervisor on Project site when vegetated roof assembly work is in progress.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of conformance with state and Federal laws if applicable.

B. Bulk Materials:

1. Do not dump or store bulk materials on or near structures, utilities, walkways and pavements, or existing roof areas or plants.
2. Provide erosion-control measures to prevent erosion or displacement of bulk materials, discharge of debris-bearing water runoff, and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
3. Accompany each delivery of bulk materials with product certificates.

C. Handle and store materials, and place equipment in a manner to avoid overloading roof structure or damaging roofing membrane.

1.9 FIELD CONDITIONS

A. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit planting to be performed when optimum results may be obtained. Apply products during favorable weather conditions in accordance with manufacturer's written instructions and warranty requirements.

1.10 WARRANTY

A. Special Warranty for Vegetated Roof Assembly: Single source warranty for wherein manufacturer and installer agrees to repair or replace components of vegetated roof assembly, including roof waterproofing, that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, ponding water or prolonged wetness of growing medium caused as a result of failure of the assembly to properly drain.
2. Warranty Period: 10 years from date of Substantial Completion.

B. Special Warranty for Plant Growth: Installer agrees to repair or replace plantings and accessories that fail in materials, workmanship, or growth within specified warranty period.

1. Foliage Cover: Planted materials to grow to achieve and maintain at least 80 percent foliage cover over planting area commencing 24 months after planting, through the duration of this warranty.
2. Failures include, but are not limited to, death and unsatisfactory growth except for defects resulting from abuse, lack of adequate maintenance, neglect by Owner, or incidents that are beyond Contractor's control.
3. Warranty Period: From date of Substantial Completion as follows:

    a. Ground Covers, Perennials, Vines, and Ornamental Grasses: Five years.

4. Include the following remedial actions as a minimum:

    a. Immediately remove dead plants and replace unless required to plant in the succeeding planting season.
    b. Replace plants that are more than 25 percent dead or in an unhealthy condition at end of warranty period.
    c. A limit of one replacement of each plant will be required except for losses or replacements due to failure to comply with requirements.

5. Provide extended warranty for period equal to original warranty period, for replaced plant material.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Obtain roof waterproofing, vegetated roof assembly components, growing medium, walkway pavers, and supports, separation geotextile, and accessories from single source from single manufacturer or from source approved in writing by vegetated roof assembly manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Rational Curve Number (RCN): Provide system with an equivalent RCN of 77.

2.3 VEGETATED ROOF ASSEMBLIES

A. Continuous Vegetated Roof Assembly: Continuous-coverage assembly consisting of manufacturer's standard vegetated roof assembly components for installation over roofing system.

1. Basis-of-Design Product: Subject to compliance with requirements, provide **American Hydrotech, Inc.; Garden Roof Rock Mineral Wool Assembly** or a comparable product by one of the following:

    a. Furbish.
    b. Sempergreen.

2. Assembly Depth, Nominal: Manufacturer's standard for required plantings as shown on Drawings, including growing medium and as follows:

a. Growing Media Depth: 3-1/4 inch.
b. Mineral Wool Depth: 1 inch.

3. Assembly Weight: Maximum 38 lb/sq. ft., including growing medium and plants and saturated with captured water, but not including weight of roofing system.
4. Plantings: Manufacturer's replanted vegetative mat including species as indicated in the Green Roof Plant Schedule on the Drawings.

a. Basis-of-Design Product: Subject to compliance with requirement, provide **American Hydrotech, Inc.; InstaGreen Sedum Carpet** or comparable product.

2.4 VEGETATED ROOF ASSEMBLY COMPONENTS

A. Separation and Root Barrier Protection Course: Vegetated roof assembly manufacturer's combination fiberglass reinforced rubberized asphalt protection sheet and polyethylene root barrier; formulated to resist root growth and bacteria.

1. Basis-of-Design Product: Subject to compliance with requirement, provide **American Hydrotech, Inc.; Hydroflex 30 and Root Stop HD** or comparable product.

B. Foam Plastic Board Insulation: As specified in Section 07 14 13 "Hot-Fluid-Applied Rubberized Asphalt Waterproofing."

C. Air and Drainage Layer: Manufacturer's standard polypropylene entangled mesh with fabric backing.

1. Basis-of-Design Product: Subject to compliance with requirement, provide **American Hydrotech, Inc.; Hydrodrain Max** or comparable product.
2. Thickness: 3/4 inch nominal.

D. Rock Mineral Wool Moisture-Retention Layer: Manufacturer's recommended mineral wool batting complying with the following:

1. Type: Needled rock mineral wool.
2. Density: 8.43 lbs. per cu. ft.
3. Thickness: 1.02 inches.

E. Filter Fabric: Non-woven, polymeric, geotextile fabric.

1. Basis-of-Design Product: Subject to compliance with requirement, provide **American Hydrotech, Inc.; Systemfilter** or comparable product.

F. Recycled Content: Provide products with postconsumer recycled content plus one-half of preconsumer recycled content to the extent required to comply with the minimum criteria specified in Section 01 81 13.14 "Sustainable Design Requirements."

2.5 MANUFACTURED GROWING MEDIA

A. Growing Medium: Vegetated roof assembly manufacturer's manufactured soil mixture designed for plants indicated on Drawings.

1. Basis-of-Design Product: Subject to compliance with requirements, provide American **Hydrotech; Intensive LiteTop Growing Media** or a comparable product by one of the following:

    a. Midwest Trading Horticultural Supplies, Inc.; a Midwest-Orum Company.
    b. Skyland USA.
    c. Stancills, Inc.
    d. WeCare Denali, LLC.
    e. Wolf Mountain Products, LLC.

2. General Condition at Time of Planting: Free of aggregates 1/2 inch or larger in any dimension; free of roots, plants, clods, pockets of sand, paint, building debris, oils, solvents, roofing materials, and other extraneous materials harmful to plant growth; free of weeds, disease-causing plant pathogens, and other undesirable organisms.
3. Initial Media Density: ASTM E2399, 55 - 75 lb/cu. ft. for basic growing-medium mixture.
4. Maximum Media Density: ASTM E2399, 76 - 93 lb/cu. ft. for basic growing-medium mixture.
5. Maximum Media Water Retention: ASTM E2399, as follows:

    a. Saturated Water Capacity: Greater than 40 percent.
    b. Saturated Air Content: Greater than 10 percent.
    c. Total Pore Space: Greater than 45 percent.

6. Water Permeability: ASTM E2399, Greater than 10 in/hr. for basic growing-medium mixture at maximum media density.
7. Chemical Properties:

    a. Growing-Medium pH (Reaction): 6.0 to 8.0.
    b. EC Salt Content: Less than 3.0 mmhos per cm.
    c. Organic Matter Content: ASTM F1647; 6 – 12 percent.

2.6 WALKWAY PAVERS

A. Heavyweight Concrete Walkway Pavers: Heavyweight, hydraulically pressed, concrete units, square edged, manufactured for use as roof- or plaza-deck pavers; with absorption not greater than 5 percent in accordance with ASTM C140; with no breakage and maximum 1 percent mass loss when tested for freeze-thaw resistance in accordance with ASTM C67.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Hanover Architectural Products.
    b. Wausau Tile, Inc.
    c. Westile Roofing Products; Oldcastle APG, Inc.; CRH Americas, Inc.

2. Thickness: 2 inches.
3. Face Size: 24 inches square.
4. Weight: 25 lb/sq. ft..
5. Compressive Strength: 8500 psi minimum when tested in accordance with ASTM C140.
6. Color: As preselected and indicated in Finish Schedule.

B. Paver Supports: Paver manufacturer's standard SBR rubber, high-density polyethylene, or polyurethane paver support assembly, including adjustable or stackable pedestals, shims, and spacer tabs for joint spacing of 1/8 to 3/16 inch.

2.7 ACCESSORIES

A. Access Boxes: Manufacturer's standard stainless steel or aluminum boxes with removable, rigid covers for accessing drains, valves, and switches beneath the finish elevation of growing medium; secure each cover with four noncorrosive screws.

1. Basis-of-Design Product: Subject to compliance with requirements, provide **American Hydrotech, Inc.; GardenHatch Inspection Chambers** or a comparable product.

2. Size: 18 inches square by depth of vegetated roof assembly at each location.

B. Soil Retainer: Vegetated roof assembly manufacturer's extruded-aluminum or formed stainless steel edging with drainage openings.

1. Configuration: As shown on Drawings.
2. Color: Mill-finish metal.
3. Method of Attachment: Manufacturer's standard adhesive compatible with the roofing system.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine each area to receive vegetated roof assembly for compliance with requirements for installation tolerances and other conditions affecting performance.

1. Verify that roof insulation over roofing membrane is in place, secure, and flush along all seams.
2. Verify that perimeter and other flashings are in place and secure along entire lengths where they will be covered by vegetated roof assembly.

B. Inspect growing medium.

1. Verify that no foreign or deleterious material or liquid, such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in growing medium within a planting area.
2. If growing medium is contaminated by foreign or deleterious material or liquid, remove growing medium and contamination and replace with new growing medium.

3.2 INSTALLATION, GENERAL

A. Separation and Root Barrier: Cover roofing system with separation and roof barrier with butted and fully taped joints before roofing system is subject to vegetated roof assembly installation work.

B. Install vegetated roof assembly in accordance with manufacturer's written instructions.

C. Access Boxes: Install access box at each drain. Install top of boxes level with the finish elevation of growing medium.

3.3 PLANTING

A. Perform planting in accordance with vegetated roof assembly manufacturer's written instructions.

B. Do not place growing medium or plants during frozen, wet, or muddy conditions.

C. Suspend spreading, grading, and planting operations during periods of excessive moisture until the moisture content in growing medium reaches acceptable levels to attain the required results.

D. Uniformly moisten an excessively dry growing medium that is too dusty or unworkable.

E. Preplanted Vegetative Mat: Install in full contact with growing medium and secure in position as indicated in the manufacturer’s written installation instructions.

3.4 INSTALLATION OF WALKWAY PAVERS

A. Installation: Install walkway pavers in accordance with manufacturer's written instructions.

B. Install paver supports in accordance with pedestal manufacturer's written instructions. Adjust for final level and slope with shims.

C. Loosely set walkway pavers, maintaining a uniform joint width. Tightly seat pavers against spacers to eliminate lateral movement or drift of paving assembly. Align joint patterns parallel in each direction.

1. Lay out pavers to avoid less-than-half-width pavers at perimeter or other terminations.

D. Tolerances: Do not exceed 1/16-inch unit-to-unit offset from flush (lippage) nor 1/8 inch in 24 inches and 1/4 inch in 10 feet from level, or indicated slope, for finished surface of paving.

3.5 INSTALLATION OF SOIL RETAINER

A. Install soil retainer where indicated in accordance with manufacturer's written instructions.

3.6 PROTECTION

A. Protect vegetated roof assemblies from damage, including growing-medium contamination, due to operations of other contractors and trades. Repair or replace damaged vegetated roof assemblies.

3.7 MAINTENANCE SERVICE

A. Maintenance Service: Provide maintenance by skilled employees of vegetated roof assembly Installer approved by roofing-membrane manufacturer. Begin maintenance immediately after plants are installed and continue until plantings are acceptably healthy and well established but for not less than the specified maintenance period.

1. Assembly and Plant Maintenance: During maintenance period, maintain plantings by pruning, cultivating, watering, weeding, fertilizing, mulching, restoring planting saucers, adjusting and repairing devices, resetting plants to proper elevations or vertical position, and performing other operations as required to establish healthy, viable plantings. Spray or treat as required to keep trees and shrubs free of insects and disease.

a. Replace growing medium that becomes displaced or eroded because of settling or other processes.
b. Apply treatments as required to keep plant materials, planted areas, and growing medium free of pests and pathogens or disease. Use integrated past management practices whenever possible to minimize the use of pesticides and reduce hazards. Treatments include physical controls such as hosing off foliage, mechanical controls such as traps, and biological control agents.
c. Use only products and methods acceptable to roofing-membrane manufacturer.

2. Maintenance Period: Two full growing seasons from the date of Planting Completion.

END OF SECTION

This page is intentionally left blank.

SECTION 07 81 00 - APPLIED FIRE PROTECTION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Sprayed fire-resistive materials.

1.2 DEFINITIONS

A. SFRM: Sprayed fire-resistive materials.

1.3 ACTION SUBMITTALS

A. Product Data:

1. Sprayed fire-resistive materials.
2. Substrate primers.
3. Bonding agent.

B. Sustainable Design Submittals:

1. Product Data: For paints and coatings, indicating VOC content.
2. Laboratory Test Reports: For paints and coatings, indicating compliance with requirements for low-emitting materials.
3. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.

C. Shop Drawings: Framing plans or schedules, or both, indicating the following:

1. Extent of fire protection for each construction and fire-resistance rating.
2. Applicable fire-resistance design designations of a qualified testing and inspecting agency acceptable to authorities having jurisdiction.
3. Minimum sprayed fire-resistive material thicknesses needed to achieve required fire-resistance rating of each structural component and assembly.
4. Treatment of sprayed fire-resistive material after application.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Certificates: For each type of sprayed fire-resistive material.

C. Evaluation Reports: For sprayed fire-resistive material, from ICC-ES.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: A firm or individual certified, licensed, or otherwise qualified by sprayed fire-resistive material manufacturer as experienced and with sufficient trained staff to install manufacturer's products in accordance with specified requirements.

1.6 FIELD CONDITIONS

A. Environmental Limitations: Do not apply fire protection when ambient or substrate temperature is 44 deg F or lower unless temporary protection and heat are provided to maintain temperature at or above this level for 24 hours before, during, and for 24 hours after product application.

B. Ventilation: Ventilate building spaces during and after application of fire protection, providing complete air exchanges in accordance with manufacturer's written instructions. Use natural means or, if they are inadequate, forced-air circulation until fire protection dries thoroughly.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Assemblies: Provide fire protection, including auxiliary materials, in accordance with requirements of each fire-resistance design and manufacturer's written instructions.

B. Source Limitations: Obtain fire protection from single source.

C. Fire-Resistance Design: Indicated on Drawings, tested in accordance with ASTM E119 or UL 263; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Steel members are to be considered unrestrained unless specifically noted otherwise.

D. VOC Content: For field applications, verify coatings comply with VOC content limits of authorities having jurisdiction and the following VOC content limits:

1. Flat Paints and Coatings: 50 g/L.
2. Nonflat Paints and Coatings: 100 g/L.
3. Primers, Sealers, and Undercoaters: 100 g/L.

E. Low-Emitting Materials: For field applications, verify coatings comply with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

F. Asbestos: Provide products containing no detectable asbestos.

2.2 SPRAYED FIRE-RESISTIVE MATERIALS

A. Sprayed Fire-Resistive Material: Manufacturer's standard, factory-mixed, lightweight, dry formulation, complying with indicated fire-resistance design, and mixed with water at Project site to form a slurry or mortar before conveyance and application.

1. Products: Subject to compliance with requirements, provide one of the following:

    a. GCP Applied Technologies Inc.; Monokote Z-106.
    b. Isolatek International; Cafco 400.
    c. Southwest Fireproofing Products Co.; Type 7GP.

2. Bond Strength: Minimum 430-lbf/sq. ft. cohesive and adhesive strength based on field testing in accordance with ASTM E736.
3. Density: 22 pcf but not less than density specified in the approved fire-resistance design, in accordance with ASTM E605.
4. Thickness: As required for fire-resistance design indicated, measured in accordance with requirements of fire-resistance design or ASTM E605, whichever is thicker, but not less than 0.375 inch.
5. Combustion Characteristics: ASTM E136.
6. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

    a. Flame-Spread Index: 10 or less.
    b. Smoke-Developed Index: 10 or less.

7. Compressive Strength: Minimum 50 lbf/sq. in. in accordance with ASTM E761.
8. Corrosion Resistance: No evidence of corrosion in accordance with ASTM E937.
9. Deflection: No cracking, spalling, or delamination in accordance with ASTM E759.
10. Air Erosion: Maximum weight loss of 0.025 g/sq. ft. in 24 hours in accordance with ASTM E859.
11. Finish: Spray-textured finish.

2.3 AUXILIARY MATERIALS

A. Provide auxiliary materials that are compatible with sprayed fire-resistive material and substrates and are approved by UL or another testing and inspecting agency acceptable to authorities having jurisdiction for use in fire-resistance designs indicated.

B. Substrate Primers: Primers approved by sprayed fire-resistive material manufacturer and complying with one or both of the following requirements:

1. Primer and substrate are identical to those tested in required fire-resistance design by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.
2. Primer's bond strength in required fire-resistance design complies with specified bond strength for sprayed fire-resistive material and with requirements in UL's "Fire Resistance Directory" or in the listings of another qualified testing agency acceptable to authorities having jurisdiction, based on a series of bond tests in accordance with ASTM E736.

C. Bonding Agent: Product approved by sprayed fire-resistive material manufacturer and complying with requirements in UL's "Fire Resistance Directory" or in the listings of another qualified testing agency acceptable to authorities having jurisdiction.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for substrates and other conditions affecting performance of the Work and in accordance with each fire-resistance design.

1. Verify that substrates are free of dirt, oil, grease, release agents, rolling compounds, mill scale, loose scale, incompatible primers, paints, and encapsulants, or other foreign substances capable of impairing bond of fire protection with substrates under conditions of normal use or fire exposure.
2. Verify that objects penetrating fire protection, including clips, hangers, support sleeves, and similar items, are securely attached to substrates.
3. Verify that substrates receiving fire protection are not obstructed by ducts, piping, equipment, or other suspended construction that will interfere with fire protection application.

B. Verify that concrete work on steel deck is complete before beginning Work.

C. Verify that roof construction, installation of rooftop HVAC equipment, and other related work are complete before beginning Work.

D. Conduct tests in accordance with sprayed fire-resistive material manufacturer's written instructions to verify that substrates are free of substances capable of interfering with bond.

E. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

F. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Cover other work subject to damage from fallout or overspray of fire protection materials during application.

B. Clean substrates of substances that could impair bond of fire protection.

C. Prime substrates where included in fire-resistance design and where recommended in writing by sprayed fire-resistive material manufacturer unless compatible shop primer has been applied and is in satisfactory condition to receive fire protection.

3.3 APPLICATION

A. Construct fire protection assemblies that are identical to fire-resistance design indicated and products as specified, tested, and substantiated by test reports; for thickness, primers, sealers, topcoats, finishing, and other materials and procedures affecting fire protection Work.

B. Comply with sprayed fire-resistive material manufacturer's written instructions for mixing materials, application procedures, and types of equipment used to mix, convey, and apply fire

protection; as applicable to particular conditions of installation and as required to achieve fire-resistance ratings indicated.

C. Coordinate application of fire protection with other construction to minimize need to cut or remove fire protection.

1. Do not begin applying fire protection until clips, hangers, supports, sleeves, and other items penetrating fire protection are in place.
2. Defer installing ducts, piping, and other items that would interfere with applying fire protection until application of fire protection is completed.

D. Metal Decks:

1. Do not apply fire protection to underside of metal deck substrates until concrete topping, if any, is completed.
2. Do not apply fire protection to underside of metal roof deck until roofing is completed; prohibit roof traffic during application and drying of fire protection.

E. Install auxiliary materials as required, as detailed, and in accordance with fire-resistance design and sprayed fire-resistive material manufacturer's written instructions for conditions of exposure and intended use. For auxiliary materials, use attachment and anchorage devices of type recommended in writing by sprayed fire-resistive material manufacturer.

F. Spray apply fire protection to maximum extent possible. After the spraying operation in each area, complete the coverage by trowel application or other placement method recommended in writing by sprayed fire-resistive material manufacturer.

G. Extend fire protection in full thickness over entire area of each substrate to be protected.

H. Install body of fire protection in a single course unless otherwise recommended in writing by sprayed fire-resistive material manufacturer.

I. Provide a uniform finish complying with description indicated for each type of fire protection material and matching finish approved for required mockups.

J. Cure fire protection in accordance with sprayed fire-resistive material manufacturer's written instructions.

K. Do not install enclosing or concealing construction until after fire protection has been applied, inspected, and tested and corrections have been made to deficient applications.

L. Finishes: Where indicated, apply fire protection to produce the following finishes:

1. Manufacturer's Standard Finishes: Finish in accordance with manufacturer's written instructions for each finish selected.
2. Spray-Textured Finish: Finish left as spray applied with no further treatment.

3.4 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:

1. Test and inspect as required by the IBC, Subsection 1705.13, "Sprayed Fire-Resistant Materials.", and as indicated on Schedule of Special Inspections.

B. Perform the tests and inspections of completed Work in successive stages. Do not proceed with application of fire protection for the next area until test results for previously completed applications of fire protection show compliance with requirements. Tested values must equal or exceed values as specified and as indicated and required for approved fire-resistance design.

C. Fire protection will be considered defective if it does not pass tests and inspections.

1. Remove and replace fire protection that does not pass tests and inspections, and retest.
2. Apply additional fire protection, in accordance with manufacturer's written instructions, where test results indicate insufficient thickness, and retest.

3.5 CLEANING

A. Cleaning: Immediately after completing spraying operations in each containable area of Project, remove material overspray and fallout from surfaces of other construction and clean exposed surfaces to remove evidence of soiling.

3.6 PROTECTION

A. Protect fire protection, according to advice of manufacturer and Installer, from damage resulting from construction operations or other causes, so fire protection is without damage or deterioration at time of Substantial Completion.

3.7 REPAIRS

A. As installation of other construction proceeds, inspect fire protection and repair damaged areas and fire protection removed due to work of other trades.

B. Repair fire protection damaged by other work before concealing it with other construction.

C. Repair fire protection by reapplying it using same method as original installation or using manufacturer's recommended trowel-applied product.

END OF SECTION

SECTION 07 84 13 - PENETRATION FIRESTOPPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Penetration firestopping systems for the following applications:

a. Penetrations in fire-resistance-rated walls.
b. Penetrations in horizontal assemblies.
c. Penetrations in smoke barriers.

B. Related Requirements:

1. Section 07 84 43 "Joint Firestopping" for joints in or between fire-resistance-rated construction, at exterior curtain-wall/floor intersections, and in smoke barriers.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:

1. Product Data: For sealants, indicating VOC content.
2. Laboratory Test Reports: For sealants, indicating compliance with requirements for low-emitting materials.

C. Product Schedule: For each penetration firestopping system. Include location, illustration of firestopping system, and design designation of qualified testing and inspecting agency.

1. Engineering Judgments: Where Project conditions require modification to a qualified testing and inspecting agency's illustration for a particular penetration firestopping system, submit illustration, with modifications marked, approved by penetration firestopping system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly. Obtain approval of authorities having jurisdiction prior to submittal.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Test Reports: For each penetration firestopping system, for tests performed by a qualified testing agency.

1.5 CLOSEOUT SUBMITTALS

A. Installer Certificates: From Installer indicating that penetration firestopping systems have been installed in compliance with requirements and manufacturer's written instructions.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: A firm that has been approved by FM Approval according to FM Approval 4991, "Approval Standard for Firestop Contractors," or been evaluated by UL and found to comply with its "Qualified Firestop Contractor Program Requirements."

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Do not install penetration firestopping system when ambient or substrate temperatures are outside limits permitted by penetration firestopping system manufacturers or when substrates are wet because of rain, frost, condensation, or other causes.

B. Install and cure penetration firestopping materials per manufacturer's written instructions using natural means of ventilations or, where this is inadequate, forced-air circulation.

1.8 COORDINATION

A. Coordinate construction of openings and penetrating items to ensure that penetration firestopping systems can be installed according to specified firestopping system design.

B. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate penetration firestopping systems.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design penetration firestopping related to design modifications requiring an Engineering Judgement, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Fire-Test-Response Characteristics:

1. Perform penetration firestopping system tests by a qualified testing agency acceptable to authorities having jurisdiction.
2. Test per testing standards referenced in "Penetration Firestopping Systems" Article. Provide rated systems complying with the following requirements:

a. Penetration firestopping systems shall bear classification marking of a qualified testing agency.

1) UL in its "Fire Resistance Directory."
2) Intertek Group in its "Directory of Listed Building Products."
3) FM Approval in its "Approval Guide."

2.2 PENETRATION FIRESTOPPING SYSTEMS

A. Penetrations in Fire-Resistance-Rated Walls: Penetration firestopping systems with ratings determined per ASTM E814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg.

1. F-Rating: Not less than the fire-resistance rating of constructions penetrated.

B. Penetrations in Horizontal Assemblies: Penetration firestopping systems with ratings determined per ASTM E814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg.

1. F-Rating: At least one hour, but not less than the fire-resistance rating of constructions penetrated.
2. T-Rating: At least one hour, but not less than the fire-resistance rating of constructions penetrated except for floor penetrations within the cavity of a wall.

C. Penetrations in Smoke Barriers: Penetration firestopping systems with ratings determined per UL 1479, based on testing at a positive pressure differential of 0.30-inch wg.

1. L-Rating: Not exceeding 5.0 cfm/sq. ft. of penetration opening at and no more than 50-cfm cumulative total for any 100 sq. ft. at both ambient and elevated temperatures.

D. Exposed Penetration Firestopping Systems: Flame-spread and smoke-developed indexes of less than 25 and 450, respectively, per ASTM E84.

1. Verify sealant has a VOC content of 250 g/L or less.
2. Verify sealant complies with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

E. Manufactured Piping Penetration Firestopping System: Penetration firestopping systems with ratings determined per ASTM E814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. ProVent Systems, Inc.
b. RectorSeal Firestop; a CSW Industrials Company.

2. F-Rating: At least one hour, but not less than the fire-resistance rating of constructions penetrated.

3. T-Rating: At least one hour, but not less than the fire-resistance rating of constructions penetrated except for floor penetrations within the cavity of a wall.
4. Sleeve: Molded-PVC plastic, of length to match slab thickness and with integral nailing flange on one end for installation in cast-in-place concrete slabs.
5. Stack Fitting: ASTM A48/A48M, gray-iron, hubless-pattern wye branch with neoprene O-ring at base and gray-iron plug in thermal-release harness. Include PVC protective cap for plug.
6. Special Coating: Corrosion resistant on interior of fittings.

F. Accessories: Provide components for each penetration firestopping system that are needed to install fill materials and to maintain ratings required. Use only those components specified by penetration firestopping system manufacturer and approved by qualified testing and inspecting agency for conditions indicated.

1. Permanent forming/damming/backing materials.
2. Substrate primers.
3. Collars.
4. Steel sleeves.

2.3 FILL MATERIALS

A. Cast-in-Place Firestop Devices: Factory-assembled devices for use in cast-in-place concrete floors and consisting of an outer sleeve lined with an intumescent strip, a flange attached to one end of the sleeve for fastening to concrete formwork, and a neoprene gasket.

B. Latex Sealants: Single-component latex formulations that do not re-emulsify after cure during exposure to moisture.

C. Firestop Devices: Factory-assembled collars formed from galvanized steel and lined with intumescent material sized to fit specific diameter of penetrant.

D. Intumescent Composite Sheets: Rigid panels consisting of aluminum-foil-faced intumescent elastomeric sheet bonded to galvanized-steel sheet.

E. Intumescent Putties: Nonhardening, water-resistant, intumescent putties containing no solvents or inorganic fibers.

F. Intumescent Wrap Strips: Single-component intumescent elastomeric sheets with aluminum foil on one side.

G. Mortars: Prepackaged dry mixes consisting of a blend of inorganic binders, hydraulic cement, fillers and lightweight aggregate formulated for mixing with water at Project site to form a nonshrinking, homogeneous mortar.

H. Pillows/Bags: Reusable heat-expanding pillows/bags consisting of glass-fiber cloth cases filled with a combination of mineral-fiber, water-insoluble expansion agents, and fire-retardant additives. Where exposed, cover openings with steel-reinforcing wire mesh to protect pillows/bags from being easily removed.

I. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

J. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants.

2.4 MIXING

A. Penetration Firestopping Materials: For those products requiring mixing before application, comply with penetration firestopping system manufacturer's written instructions for accurate proportioning of materials, water (if required), type of mixing equipment, selection of mixer speeds, mixing containers, mixing time, and other items or procedures needed to produce products of uniform quality with optimum performance characteristics for application indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning: Before installing penetration firestopping systems, clean out openings immediately to comply with manufacturer's written instructions and with the following requirements:

1. Remove from surfaces of opening substrates and from penetrating items foreign materials that could interfere with adhesion of penetration firestopping materials.
2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with penetration firestopping materials. Remove loose particles remaining from cleaning operation.
3. Remove laitance and form-release agents from concrete.

B. Prime substrates where recommended in writing by manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

3.3 INSTALLATION

A. General: Install penetration firestopping systems to comply with manufacturer's written installation instructions and published drawings for products and applications.

B. Install forming materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings.

1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not forming permanent components of firestopping.

C. Install fill materials by proven techniques to produce the following results:

1. Fill voids and cavities formed by openings, forming materials, accessories and penetrating items to achieve required fire-resistance ratings.
2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
3. For fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4 IDENTIFICATION

A. Wall Identification: Permanently label walls containing penetration firestopping systems with the words "FIRE AND/OR SMOKE BARRIER - PROTECT ALL OPENINGS," using lettering not less than 3 inches high and with minimum 0.375-inch strokes.

1. Locate in accessible concealed floor, floor-ceiling, or attic space at 15 feet from end of wall and at intervals not exceeding 30 feet.

3.5 FIELD QUALITY CONTROL

A. Owner will engage a qualified testing agency to perform tests and inspections according to ASTM E2174.

B. Where deficiencies are found or penetration firestopping system is damaged or removed because of testing, repair or replace penetration firestopping system to comply with requirements.

C. Proceed with enclosing penetration firestopping systems with other construction only after inspection reports are issued and installations comply with requirements.

3.6 CLEANING AND PROTECTION

A. Clean off excess fill materials adjacent to openings as the Work progresses by methods and with cleaning materials that are approved in writing by penetration firestopping system manufacturers and that do not damage materials in which openings occur.

B. Provide final protection and maintain conditions during and after installation that ensure that penetration firestopping systems are without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, immediately cut out and remove damaged or deteriorated penetration firestopping material and install new materials to produce systems complying with specified requirements.

3.7 PENETRATION FIRESTOPPING SYSTEM SCHEDULE

A. Where UL-classified systems are indicated, they refer to system numbers in UL's "Fire Resistance Directory" under product Category XHEZ.

B. Where Intertek Group-listed systems are indicated, they refer to design numbers in Intertek Group's "Directory of Listed Building Products" under "Firestop Systems."

C. Where FM Approval-approved systems are indicated, they refer to design numbers listed in FM Approval's "Approval Guide" under "Wall and Floor Penetration Fire Stops."

D. Install firestop sealants in accordance with approved manufacturer's systems and applications schedule for penetrating material, opening type, and type of construction penetrated. Manufacturer's schedule shall indicate the independent testing laboratory design number for each system and application. Schedule shall cover at a minimum the following conditions:

1. Firestopping with No Penetrating Items.
2. Firestopping for Metallic Pipes, Conduit, or Tubing.
3. Firestopping for Nonmetallic Pipe, Conduit, or Tubing.
4. Firestopping for Electrical Cables.
5. Firestopping for Cable Trays with Electric Cables.
6. Firestopping for Insulated Pipes.
7. Firestopping for Miscellaneous Electrical Penetrants.
8. Firestopping for Miscellaneous Mechanical Penetrants.
9. Firestopping for Groupings of Penetrants.

END OF SECTION

This page is intentionally left blank.

SECTION 07 84 43 - JOINT FIRESTOPPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Joints in or between fire-resistance-rated constructions.
2. Joints at exterior curtain-wall/floor intersections.
3. Joints in smoke barriers.

B. Related Requirements:

1. Section 07 84 13 "Penetration Firestopping" for penetrations in fire-resistance-rated walls, horizontal assemblies, and smoke barriers and for wall identification.
2. Section 09 22 16 "Non-Structural Metal Framing" for firestop tracks for metal-framed partition heads.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:

1. Product Data: For sealants, indicating VOC content.
2. Laboratory Test Reports: For sealants, indicating compliance with requirements for low-emitting materials.

C. Product Schedule: For each joint firestopping system. Include location, illustration of firestopping system, and design designation of qualified testing agency.

1. Engineering Judgments: Where Project conditions require modification to a qualified testing agency's illustration for a particular joint firestopping system condition, submit illustration, with modifications marked, approved by joint firestopping system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Test Reports: For each joint firestopping system, for tests performed by a qualified testing agency.

1.5 CLOSEOUT SUBMITTALS

A. Installer Certificates: From Installer indicating that joint firestopping systems have been installed in compliance with requirements and manufacturer's written instructions.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: A firm that has been approved by FM Approvals according to FM Approvals 4991, "Approval of Firestop Contractors," or been evaluated by UL and found to comply with UL's "Qualified Firestop Contractor Program Requirements."

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Do not install joint firestopping systems when ambient or substrate temperatures are outside limits permitted by joint firestopping system manufacturers or when substrates are wet due to rain, frost, condensation, or other causes.

B. Install and cure joint firestopping systems per manufacturer's written instructions using natural means of ventilation or, where this is inadequate, forced-air circulation.

1.8 COORDINATION

A. Coordinate construction of joints to ensure that joint firestopping systems can be installed according to specified firestopping system design.

B. Coordinate sizing of joints to accommodate joint firestopping systems.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design joint firestopping related to design modifications requiring an Engineering Judgement, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Fire-Test-Response Characteristics:

1. Perform joint firestopping system tests by a qualified testing agency acceptable to authorities having jurisdiction.
2. Test per testing standards referenced in "Joint Firestopping Systems" Article. Provide rated systems complying with the following requirements:

a. Joint firestopping systems shall bear classification marking of a qualified testing agency.

1) UL in its "Fire Resistance Directory."
2) Intertek Group in its "Directory of Listed Building Products."

2.2 JOINT FIRESTOPPING SYSTEMS

A. Joint Firestopping Systems: Systems that resist spread of fire, passage of smoke and other gases, and maintain original fire-resistance rating of assemblies in or between which joint firestopping systems are installed. Joint firestopping systems shall accommodate building movements without impairing their ability to resist the passage of fire and hot gases.

B. Joints in or between Fire-Resistance-Rated Construction: Provide joint firestopping systems with ratings determined per ASTM E1966 or UL 2079.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. 3M Fire Protection Products.
b. Hilti, Inc.
c. ROCKWOOL.
d. Specified Technologies, Inc.
e. Tremco, Inc.

2. Fire-Resistance Rating: Equal to or exceeding the fire-resistance rating of the wall, floor, or roof in or between which it is installed.

C. Joints at Exterior Curtain-Wall/Floor Intersections: Provide joint firestopping systems with rating determined per ASTM E2307.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. 3M Fire Protection Products.
b. Hilti, Inc.
c. ROCKWOOL.
d. Specified Technologies, Inc.
e. Tremco, Inc.

2. F-Rating: Equal to or exceeding the fire-resistance rating of the floor assembly.

D. Joints in Smoke Barriers: Provide joint firestopping systems with ratings determined per UL 2079 based on testing at a positive pressure differential of 0.30-inch wg.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. 3M Fire Protection Products.
b. Hilti, Inc.
c. ROCKWOOL.

d. Specified Technologies, Inc.
e. Tremco, Inc.

2. L-Rating: Not exceeding 5.0 cfm/ft. of joint at both ambient and elevated temperatures.

E. Exposed Joint Firestopping Systems: Flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E84.

1. Verify sealant has a VOC content of 250 g/L or less.
2. Verify sealant complies with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

F. Accessories: Provide components of joint firestopping systems, including primers and forming materials, that are needed to install elastomeric fill materials and to maintain ratings required. Use only components specified by joint firestopping system manufacturer and approved by the qualified testing agency for conditions indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for joint configurations, substrates, and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning: Before installing joint firestopping systems, clean joints immediately to comply with fire-resistive joint system manufacturer's written instructions and the following requirements:

1. Remove from surfaces of joint substrates foreign materials that could interfere with adhesion of elastomeric fill materials or compromise fire-resistive rating.
2. Clean joint substrates to produce clean, sound surfaces capable of developing optimum bond with elastomeric fill materials. Remove loose particles remaining from cleaning operation.
3. Remove laitance and form-release agents from concrete.

B. Prime substrates where recommended in writing by joint firestopping system manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

3.3 INSTALLATION

A. General: Install joint firestopping systems to comply with manufacturer's written installation instructions and published drawings for products and applications indicated.

B. Install forming materials and other accessories of types required to support elastomeric fill materials during their application and in position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.

1. After installing elastomeric fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not indicated as permanent components of fire-resistive joint system.

C. Install elastomeric fill materials for joint firestopping systems by proven techniques to produce the following results:

1. Elastomeric fill voids and cavities formed by joints and forming materials as required to achieve fire-resistance ratings indicated.
2. Apply elastomeric fill materials so they contact and adhere to substrates formed by joints.
3. For elastomeric fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4 FIELD QUALITY CONTROL

A. Inspecting Agency: Owner will engage a qualified testing agency to perform tests and inspections according to ASTM E2393.

B. Where deficiencies are found or joint firestopping systems are damaged or removed due to testing, repair or replace joint firestopping systems so they comply with requirements.

C. Proceed with enclosing joint firestopping systems with other construction only after inspection reports are issued and installations comply with requirements.

3.5 CLEANING AND PROTECTION

A. Clean off excess elastomeric fill materials adjacent to joints as the Work progresses by methods and with cleaning materials that are approved in writing by joint firestopping system manufacturers and that do not damage materials in which joints occur.

B. Provide final protection and maintain conditions during and after installation that ensure joint firestopping systems are without damage or deterioration at time of Substantial Completion. If damage or deterioration occurs despite such protection, cut out and remove damaged or deteriorated joint firestopping systems immediately and install new materials to produce joint firestopping systems complying with specified requirements.

3.6 JOINT FIRESTOPPING SYSTEM SCHEDULE

A. Where UL-classified systems are indicated, they refer to system numbers in UL's "Fire Resistance Directory" under product Category XHBN or Category XHDG.

B. Where Intertek Group-listed systems are indicated, they refer to design numbers in Intertek Group's "Directory of Listed Building Products" under "Firestop Systems."

C. Install joint firestopping sealants in accordance with approved manufacturer’s systems and applications schedule for penetrating material, opening type, and type of construction

penetrated. Manufacturer's schedule shall indicate the independent testing laboratory design number for each system and application. Schedule shall cover at a minimum the following conditions:

1. Floor-to-Floor, Fire-Resistive Joint Systems.
2. Wall-to-Wall, Fire-Resistive Joint Systems.
3. Floor-to-Wall, Fire-Resistive Joint Systems.
4. Head-of-Wall, Fire-Resistive Joint Systems.
5. Bottom-of-Wall, Fire-Resistive Joint Systems.
6. Wall-to-Wall, Fire-Resistive Joint Systems Intended for Use as Corner Guards.
7. Perimeter Fire-Resistive Joint Systems.

END OF SECTION

SECTION 07 92 00 - JOINT SEALANTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Silicone joint sealants.
2. Nonstaining silicone joint sealants.
3. Urethane joint sealants.
4. Immersible joint sealants.
5. Mildew-resistant joint sealants.
6. Butyl joint sealants.
7. Latex joint sealants.

B. Related Requirements:

1. Section 07 92 19 "Acoustical Joint Sealants" for sealing joints in sound-rated construction.
2. Section 32 13 73 "Concrete Paving Joint Sealants" for sealing joints in paved roads, parking lots, walkways, and curbing.

1.2 ACTION SUBMITTALS

A. Product Data:

1. Joint sealants.
2. Joint-sealant backing materials.

B. Samples for Initial Selection: Manufacturer's standard color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.

C. Samples for Verification: For each type and color of joint sealant required, provide Samples with joint sealants in 1/2-inch-wide joints formed between two 6-inch-long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.

D. Joint-Sealant Schedule: Include the following information:

1. Joint-sealant application, joint location, and designation.
2. Joint-sealant manufacturer and product name.
3. Joint-sealant formulation.
4. Joint-sealant color.

1.3 INFORMATIONAL SUBMITTALS

A. Preconstruction Laboratory Test Schedule: Include the following information for each joint sealant and substrate material to be tested:

1. Joint-sealant location and designation.
2. Manufacturer and product name.
3. Type of substrate material.
4. Proposed test.
5. Number of samples required.

B. Preconstruction Laboratory Test Reports: For each joint sealant and substrate material to be tested from sealant manufacturer, indicating the following:

1. Materials forming joint substrates and joint-sealant backings have been tested for compatibility and adhesion with joint sealants.
2. Interpretation of test results and written recommendations for primers and substrate preparation are needed for adhesion.

C. Preconstruction Field-Adhesion-Test Reports: Indicate which sealants and joint preparation methods resulted in optimum adhesion to joint substrates based on testing specified in "Preconstruction Testing" Article.

D. Field Quality-Control Reports: For field-adhesion-test reports, for each sealant application tested.

E. Sample warranties.

1.4 CLOSEOUT SUBMITTALS

A. Manufacturers' special warranties.

B. Installer's special warranties.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Authorized representative who is trained and approved by manufacturer.

B. Testing Agency Qualifications: Qualified in accordance with ASTM C1021 to conduct the testing indicated.

1.6 MOCKUPS

A. Install sealant in mockups of assemblies specified in other Sections that are indicated to receive joint sealants specified in this Section. Use materials and installation methods specified in this Section.

1.7 PRECONSTRUCTION TESTING

A. Preconstruction Laboratory Testing: Submit to joint-sealant manufacturers, for testing indicated below, samples of materials that will contact or affect joint sealants.

1. Adhesion Testing: Use ASTM C794 to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.
2. Compatibility Testing: Use ASTM C1087 to determine sealant compatibility when in contact with glazing and gasket materials.
3. Stain Testing: Use ASTM C1248 to determine stain potential of sealant when in contact with masonry substrates.
4. Submit manufacturer's recommended number of pieces of each type of material, including joint substrates, joint-sealant backings, and miscellaneous materials.
5. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
6. For materials failing tests, obtain joint-sealant manufacturer's written instructions for corrective measures, including use of specially formulated primers.
7. Testing will not be required if joint-sealant manufacturers submit data that are based on previous testing, not older than 24 months, of sealant products for adhesion to, staining of, and compatibility with joint substrates and other materials matching those submitted.

B. Preconstruction Field-Adhesion Testing: Before installing sealants, field test their adhesion to Project joint substrates as follows:

1. Locate test joints where indicated on Project or, if not indicated, as directed by Architect.
2. Conduct field tests for each kind of sealant and joint substrate.
3. Notify Architect seven days in advance of dates and times when test joints will be erected.
4. Arrange for tests to take place with joint-sealant manufacturer's technical representative present.
5. Test Method: Test joint sealants in accordance with Method A, Tail Procedure, in ASTM C1521.

    a. For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.

6. Report whether sealant failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. For sealants that fail adhesively, retest until satisfactory adhesion is obtained.
7. Evaluation of Preconstruction Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing, in absence of other indications of noncompliance with requirements, will be considered satisfactory. Do not use sealants that fail to adhere to joint substrates during testing.

1.8 FIELD CONDITIONS

A. Do not proceed with installation of joint sealants under the following conditions:

1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg F.
2. When joint substrates are wet.

3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

1.9 WARRANTY

A. Special Installer's Warranty: Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period: Two years from date of Substantial Completion.

B. Special Manufacturer's Warranty: Manufacturer agrees to furnish joint sealants to repair or replace those joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

C. Special warranties specified in this article exclude deterioration or failure of joint sealants from the following:

1. Movement of the structure caused by stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression.
2. Disintegration of joint substrates from causes exceeding design specifications.
3. Mechanical damage caused by individuals, tools, or other outside agents.
4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

PART 2 - PRODUCTS

2.1 JOINT SEALANTS, GENERAL

A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.

B. VOC Content: Verify sealants and sealant primers comply with the following:

1. Architectural sealants have a VOC content of 250 g/L or less.
2. Sealants and sealant primers for nonporous substrates have a VOC content of 250 g/L or less.
3. Sealants and sealant primers for porous substrates have a VOC content of 775 g/L or less.
4. Verify sealant complies with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

C. Colors of Exposed Joint Sealants: Custom color to match adjacent surfaces as directed by Architect. There will be a minimum of five different sealant colors.

2.2 SILICONE JOINT SEALANTS

A. Silicone, S, NS, 50, NT: Single-component, nonsag, plus 50 percent and minus 50 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 50, Use NT.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. GE Construction Sealants; Momentive Performance Materials Inc.
b. Pecora Corporation.
c. Sika Corporation - Building Components.
d. The Dow Chemical Company.
e. Tremco Incorporated.

2.3 NONSTAINING SILICONE JOINT SEALANTS

A. Nonstaining Joint Sealants: No staining of substrates when tested in accordance with ASTM C1248.

B. Silicone, Nonstaining, S, NS, 50, NT: Nonstaining, single-component, nonsag, plus 50 percent and minus 50 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 50, Use NT.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. GE Construction Sealants; Momentive Performance Materials Inc.
b. Pecora Corporation.
c. Sika Corporation - Building Components.
d. The Dow Chemical Company.
e. Tremco Incorporated.

2.4 URETHANE JOINT SEALANTS

A. Urethane, S, P, 25, T, NT: Single-component, pourable, plus 25 percent and minus 25 percent movement capability, traffic- and nontraffic-use, urethane joint sealant; ASTM C920, Type S, Grade P, Class 25, Uses T and NT.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Master Builders Solutions.
b. Pecora Corporation.
c. Polymeric Systems, Inc.
d. Sherwin-Williams Company (The).

B. Urethane, M, P, 25, T, NT: Multicomponent, pourable, plus 25 percent and minus 25 percent movement capability, traffic- and nontraffic-use, urethane joint sealant; ASTM C920, Type M, Grade P, Class 25, Uses T and NT.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Master Builders Solutions.
b. Pecora Corporation.
c. Sherwin-Williams Company (The).
d. Tremco Incorporated.

2.5 MILDEW-RESISTANT JOINT SEALANTS

A. Mildew-Resistant Joint Sealants: Formulated for prolonged exposure to humidity with fungicide to prevent mold and mildew growth.

B. Silicone, Mildew Resistant, Acid Curing, S, NS, 25, NT: Mildew-resistant, single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, acid-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 25, Use NT.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Adfast.
b. GE Construction Sealants; Momentive Performance Materials Inc.
c. Pecora Corporation.
d. Sika Corporation - Building Components.
e. The Dow Chemical Company.
f. Tremco Incorporated.

2.6 BUTYL JOINT SEALANTS

A. Butyl-Rubber-Based Joint Sealants: ASTM C1311.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Bostik; Arkema.
b. Everkem Diversified Products, Inc.
c. GSSI Sealants.
d. Pecora Corporation.
e. Sika Corporation - Building Components.

2.7 LATEX JOINT SEALANTS

A. Acrylic Latex: Acrylic latex or siliconized acrylic latex, ASTM C834, Type OP, Grade NF.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Adfast.

b. Everkem Diversified Products, Inc.
c. Franklin International.
d. Pecora Corporation.
e. Sherwin-Williams Company (The).
f. Tremco Incorporated.

2.8 JOINT-SEALANT BACKING

A. Sealant Backing Material, General: Nonstaining; compatible with joint substrates, sealants, primers, and other joint fillers; and approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.

B. Cylindrical Sealant Backings: ASTM C 1330, Type B (bicellular material with a surface skin) **as** approved in writing by joint-sealant manufacturer for joint application indicated except Type O (open-cell material) at back seal of two-stage rainscreen joint, and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.

C. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint. Provide self-adhesive tape where applicable.

2.9 MISCELLANEOUS MATERIALS

A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.

B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.

C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:

1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
2. Clean porous joint substrate surfaces by brushing, grinding, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include the following:

    a. Concrete.
    b. Masonry.
    c. Unglazed surfaces of ceramic tile.

3. Remove laitance and form-release agents from concrete.
4. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include the following:

    a. Metal.
    b. Glass.
    c. Porcelain enamel.
    d. Glazed surfaces of ceramic tile.

B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.3 INSTALLATION OF JOINT SEALANTS

A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.

B. Sealant Installation Standard: Comply with recommendations in ASTM C1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

C. Install sealant backings of type indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.

1. Do not leave gaps between ends of sealant backings.
2. Do not stretch, twist, puncture, or tear sealant backings.
3. Remove absorbent sealant backings that have become wet before sealant application, and replace them with dry materials.

D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.

E. Install sealants using proven techniques that comply with the following and at the same time backings are installed:

1. Place sealants so they directly contact and fully wet joint substrates.
2. Completely fill recesses in each joint configuration.
3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

F. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified in subparagraphs below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.

1. Remove excess sealant from surfaces adjacent to joints.
2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
3. Provide concave joint profile in accordance with Figure 8A in ASTM C1193 unless otherwise indicated.

G. Two-Stage Rainscreen Joints: Install primary (back) seal continuous horizontal and vertical from exterior. Allow primary seal sufficient time to cure before installing exposed exterior seal. Install reticulated foam weep/vent through exposed exterior seal at each story or each horizontal panel joint, whichever is greater. Install connecting sealant bead between back seal and front seal below weep/vent tubes sloped to create trough directing water to reticulated foam weep/vent. Trim reticulated foam flush with sealant bead after sealant has cured.

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Tests and Inspections:

1. Field-Adhesion Testing: Field test joint-sealant adhesion to joint substrates as follows:

a. Extent of Testing: Test completed and cured sealant joints as follows:

1) Perform 10 tests for the first 1000 ft. of joint length for each kind of sealant and joint substrate.
2) Perform one test for each 1000 ft. of joint length thereafter or one test per each floor per elevation.

b. Test Method: Test joint sealants in accordance with Method A, Tail Procedure, in ASTM C1521.

1) For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.

c. Inspect tested joints and report on the following:

1) Whether sealants filled joint cavities and are free of voids.
2) Whether sealant dimensions and configurations comply with specified requirements.
3) Whether sealants in joints connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. Compare these results to determine if adhesion complies with sealant manufacturer's field-adhesion hand-pull test criteria.

d. Record test results in a field-adhesion-test log. Include dates when sealants were installed, names of persons who installed sealants, test dates, test locations, whether joints were primed, adhesion results and percent elongations, sealant material, sealant configuration, and sealant dimensions.
e. Repair sealants pulled from test area by applying new sealants following same procedures used originally to seal joints. Ensure that original sealant surfaces are clean and that new sealant contacts original sealant.

2. Evaluation of Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other indicated requirements will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.

C. Prepare test and inspection reports.

3.5 CLEANING

A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

3.6 PROTECTION

A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out, remove, and repair damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

3.7 JOINT-SEALANT SCHEDULE

A. Joint-Sealant Application: Exterior joints in horizontal traffic surfaces.

1. Indicative Joint Locations:

a. Control and expansion joints in pavers.
b. Isolation and contraction joints in cast-in-place concrete slabs.
c. Tile control and expansion joints.
d. Joints between different materials listed above.

2. Joint Sealant: Urethane, S or M, P, 25, T, NT.
3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

B. Joint-Sealant Application: Exterior joints in vertical surfaces and horizontal nontraffic surfaces.

1. Indicative Joint Locations:

a. Construction joints in cast-in-place concrete.
b. Joints between plant-precast architectural concrete units.
c. Control and expansion joints in unit masonry.
d. Joints in dimension stone cladding.
e. Joints in glass unit masonry assemblies.
f. Joints in exterior insulation and finish systems.
g. Joints between metal panels.
h. Joints between different materials listed above.
i. Perimeter joints between materials listed above and frames of doors, windows, and louvers.
j. Control and expansion joints in ceilings and other overhead surfaces.

2. Joint Sealant: Silicone, nonstaining, S, NS, 50, NT.
3. Joint-Sealant Color: Provide custom colors to match adjacent surfaces as directed by Architect.

C. Joint-Sealant Application: Interior joints in horizontal traffic surfaces.

1. Indicative Joint Locations:

a. Isolation joints in cast-in-place concrete slabs.
b. Control and expansion joints in stone flooring.
c. Control and expansion joints in tile flooring.

2. Joint Sealant: Urethane, M or S, P, 25, T, NT.
3. Joint-Sealant Color: Provide custom colors to match adjacent surfaces as directed by Architect.

D. Joint-Sealant Application: Interior joints in vertical surfaces and horizontal nontraffic surfaces.

1. Indicative Joint Locations:

a. Control and expansion joints on exposed interior surfaces of exterior walls.
b. Tile control and expansion joints.
c. Vertical joints on exposed surfaces of unit masonry, concrete, walls and partitions.

2. Joint Sealant: Silicone, S, NS, 50, NT.
3. Joint-Sealant Color: Provide custom colors to match adjacent surfaces as directed by Architect.

E. Joint-Sealant Application: Interior joints in vertical surfaces and horizontal nontraffic surfaces not subject to significant movement.

1. Indicative Joint Locations:

a. Control joints on exposed interior surfaces of exterior walls.

b. Perimeter joints between interior wall surfaces and frames of interior doors, windows, and elevator entrances.

2. Joint Sealant: Acrylic latex.
3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

F. Joint-Sealant Application: Mildew-resistant interior joints in vertical surfaces and horizontal nontraffic surfaces.

1. Indicative Joint Locations:

a. Joints between plumbing fixtures and adjoining walls, floors, and counters.
b. Tile control and expansion joints where indicated.
c. Other joints as indicated on Drawings.

2. Joint Sealant: Silicone, mildew resistant, acid curing, S, NS, 25, NT.
3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

G. Joint-Sealant Application: Concealed mastics.

1. Indicative Joint Locations:

a. Aluminum thresholds.
b. Sill plates.
c. Other joints as indicated on Drawings.

2. Joint Sealant: Butyl-rubber based.
3. Joint-Sealant Color: Black.

END OF SECTION

SECTION 07 92 19 - ACOUSTICAL JOINT SEALANTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Acoustical joint sealants.

B. Related Requirements:

1. Section 07 92 00 "Joint Sealants" for elastomeric, latex, and butyl-rubber-based joint sealants for non-acoustical applications.

1.2 ACTION SUBMITTALS

A. Product Data:

1. Acoustical joint sealants.

B. Samples for Initial Selection: Manufacturer's color charts consisting of strips of cured sealants, showing full range of available colors for each product exposed to view.

C. Samples for Verification: For each type and color of acoustical joint sealant required.

1. Size: 1/2-inch-wide sealant joints formed between two 6-inch-long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.

D. Acoustical Joint-Sealant Schedule: Include the following information:

1. Joint-sealant application, joint location, and designation.
2. Joint-sealant manufacturer and product name.
3. Joint-sealant color.

1.3 INFORMATIONAL SUBMITTALS

A. Test and Evaluation Reports:

1. Product Test Reports: For each type of acoustical joint sealant.

B. Sample warranties.

1.4 CLOSEOUT SUBMITTALS

A. Warranty Documentation:

1. Manufacturers' special warranties.
2. Installer's special warranties.

1.5 WARRANTY

A. Installer's Special Warranty: Installer agrees to repair or replace acoustical joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 ACOUSTICAL JOINT SEALANTS

A. Acoustical joint-sealant products that effectively reduce airborne sound transmission through perimeter joints and openings in building construction, as demonstrated by testing representative assemblies in accordance with ASTM E90.

1. Verify sealant has a VOC content of 250 g/L or less.
2. Verify sealant complies with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

B. Acoustical Sealant for Exposed and Concealed Joints: Manufacturer's standard nonsag, paintable, nonstaining latex acoustical sealant complying with ASTM C834.

1. Products: Subject to compliance with requirements, provide one of the following:

a. DAP.; SOUND BLOCK Acoustical, Draft, Smoke & Sound Sealant.
b. Everkem Diversified Products, Inc.; SoundSeal 90 Draft, Smoke and Acoustical Sound Sealant.
c. Franklin International; Titebond Acoustical Smoke & Sound Sealant.
d. Grabber Construction Products.; Acoustical Smoke and Sound Sealant.
e. Hilti, Inc.; CP-506 Smoke and Acoustic Sealant.
f. OSI Sealants; Henkel Corporation; SC-175 Acoustical Caulk.
g. Specified Technologies, Inc.; SNS Smoke ‘N’ Seal Acoustical Sealant.
h. USG Corporation; Sheetrock Brand Acoustical Sealant.

2. Colors of Exposed Acoustical Joint Sealants: As selected by Architect from manufacturer's full range of colors.

2.2 MISCELLANEOUS MATERIALS

A. Primer: Material recommended by acoustical joint-sealant manufacturer where required for adhesion of sealant to joint substrates.

B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or

harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.

C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine joints indicated to receive acoustical joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing acoustical joint sealants to comply with joint-sealant manufacturer's written instructions.

B. Joint Priming: Prime joint substrates where recommended by acoustical joint-sealant manufacturer. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.3 INSTALLATION OF ACOUSTICAL JOINT SEALANTS

A. Comply with acoustical joint-sealant manufacturer's written installation instructions unless more stringent requirements apply.

B. STC-Rated Assemblies: Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical joint sealant. Install acoustical joint sealants at both faces of partitions, at perimeters, and through penetrations. Comply with ASTM C919, ASTM C1193, and manufacturer's written instructions for closing off sound-flanking paths around or through assemblies, including sealing partitions to underside of floor slabs above acoustical ceilings.

C. Acoustical Ceiling Areas: Apply acoustical joint sealant at perimeter edge moldings of acoustical ceiling areas in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.

3.4 CLEANING

A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of acoustical joint sealants and of products in which joints occur.

3.5 PROTECTION

A. Protect acoustical joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out, remove, and repair damaged or deteriorated acoustical joint sealants immediately so installations with repaired areas are indistinguishable from original work.

END OF SECTION

SECTION 08 11 13 - HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:

1. Interior standard steel doors and frames.
2. Exterior standard steel doors and frames.
3. Interior custom hollow-metal doors and frames at bronze clad doors.

B. Related Requirements:

1. Section 057500 “Decorative Formed Metal” for bronze clad wall panels installed in conjunction with bronze clad doors and frames.
2. Section 087100 "Door Hardware" for door hardware for hollow-metal doors.

1.2 DEFINITIONS

A. Minimum Thickness: Minimum thickness of base metal without coatings in accordance with NAAMM-HMMA 803 or ANSI/SDI A250.8.

1.3 COORDINATION

A. Coordinate anchorage installation for hollow-metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.

B. Coordinate requirements for installation of door hardware, electrified door hardware, and access control and security systems.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, core descriptions, fire-resistance ratings, and finishes.

B. Sustainable Design Submittals:

1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.
2. Environmental Product Declaration: For each product.
3. Health Product Declaration: For each product.
4. Sourcing of Raw Materials: Corporate sustainability report for each manufacturer.

C. Shop Drawings: Include the following:

1. Elevations of each door type.
2. Details of doors, including vertical- and horizontal-edge details and metal thicknesses.
3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
4. Locations of reinforcement and preparations for hardware.
5. Details of each different wall opening condition.
6. Details of electrical raceway and preparation for electrified hardware, access control systems, and security systems.
7. Details of anchorages, joints, field splices, and connections.
8. Details of accessories.
9. Details of moldings, removable stops, and glazing.

D. Samples for Verification: For each type of exposed metal with mechanical finish required, prepared on 6-inch-square Samples of metal of same thickness and material indicated for the Work.

E. Product Schedule: For hollow-metal doors and frames, prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with final door hardware schedule.

1.5 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For each type of fire-rated hollow-metal door and frame assembly for tests performed by a qualified testing agency indicating compliance with performance requirements.

B. Oversize Construction Certification: For assemblies required to be fire-rated and exceeding limitations of labeled assemblies.

1.6 CLOSEOUT SUBMITTALS

A. Record Documents: For fire-rated doors, list of door numbers and applicable room name and number to which door accesses.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver hollow-metal doors and frames palletized, packaged, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic.

1. Provide additional protection to prevent damage to factory-finished units.

B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.

C. Store hollow-metal doors and frames vertically under cover at Project site with head up. Place on minimum 4-inch-high wood blocking. Provide minimum 1/4-inch space between each stacked door to permit air circulation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Ceco Door; AADG, Inc.; ASSA ABLOY.
2. Curries, AADG, Inc.; ASSA ABLOY Group.
3. DCI Hollow Metal on Demand.
4. Deansteel Manufacturing Company, Inc.
5. Hollow Metal Xpress.
6. MPI Group, LLC (The).
7. Mesker Door; Mesker Openings Group.
8. Pioneer Industries; AADG, Inc.; ASSA ABLOY.
9. Premier Products, Inc.
10. Republic Doors and Frames; a Allegion brand.
11. Security Metal Products; a brand of ASSA ABLOY.
12. Steelcraft; Allegion plc.

2.2 PERFORMANCE REQUIREMENTS

A. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction for fire-protection ratings indicated on Drawings, based on testing at positive pressure in accordance with NFPA 252 or UL 10C.

1. Smoke- and Draft-Control Door Assemblies: Listed and labeled for smoke and draft control by a qualified testing agency acceptable to authorities having jurisdiction, based on testing in accordance with UL 1784 and installed in compliance with NFPA 105.
2. Oversize Fire-Rated Door Assemblies: For units exceeding sizes of tested assemblies, provide certification by a qualified testing agency that doors comply with standard construction requirements for tested and labeled fire-rated door assemblies except for size.

B. Fire-Rated, Borrowed-Lite Assemblies: Assemblies complying with NFPA 80 and listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing in accordance with NFPA 257 or UL 9.

C. Thermally Rated Door Assemblies: Provide door assemblies with U-factor of not more than 0.42 deg Btu/F x h x sq. ft. when tested in accordance with ASTM C1363 or ASTM E1423.

2.3 INTERIOR STANDARD STEEL DOORS AND FRAMES

A. Construct hollow-metal doors and frames to comply with standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.

B. Heavy-Duty Doors and Frames: ANSI/SDI A250.8, Level 2; ANSI/SDI A250.4, Level B. Typical unless noted otherwise.

1. Doors:

    a. Type: As indicated in the Door and Frame Schedule.
    b. Thickness: 1-3/4 inches.
    c. Face: Uncoated steel sheet, minimum thickness of 0.042 inch.
    d. Edge Construction: Model 2, Seamless.
    e. Edge Bevel: Provide manufacturer's standard beveled or square edges.
    f. Core: Vertical steel stiffener.
    g. Fire-Rated Core: Manufacturer's standard vertical steel stiffener core for fire-rated doors.

2. Frames:

    a. Materials: Uncoated steel sheet, minimum thickness of 0.053 inch.
    b. Sidelite and Transom Frames: Fabricated from same thickness material as adjacent door frame.
    c. Construction: Full profile welded.

3. Exposed Finish: Prime.

C. Extra-Heavy-Duty Doors and Frames: ANSI/SDI A250.8, Level 3; ANSI/SDI A250.4, Level A. At stairwells and public restrooms.

1. Doors:

    a. Type: As indicated in the Door and Frame Schedule.
    b. Thickness: 1-3/4 inches.
    c. Face: Uncoated steel sheet, minimum thickness of 0.053 inch.
    d. Edge Construction: Model 2, Seamless.
    e. Edge Bevel: Provide manufacturer's standard beveled or square edges.
    f. Core: Vertical steel stiffener.
    g. Fire-Rated Core: Manufacturer's standard vertical steel stiffener core for fire-rated doors.

2. Frames:

    a. Materials: Uncoated steel sheet, minimum thickness of 0.053 inch.
    b. Sidelite and Transom Frames: Fabricated from same thickness material as adjacent door frame.
    c. Construction: Full profile welded.

3. Exposed Finish: Prime.

2.4 EXTERIOR STANDARD STEEL DOORS AND FRAMES

A. Construct hollow-metal doors and frames to comply with standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.

B. Extra-Heavy-Duty Doors and Frames: ANSI/SDI A250.8, Level 3; ANSI/SDI A250.4, Level A..

1. Doors:

a. Type: As indicated in the Door and Frame Schedule.
b. Thickness: 1-3/4 inches.
c. Face: Metallic-coated steel sheet, minimum thickness of 0.053 inch, with minimum A40 coating.
d. Edge Construction: Model 2, Seamless.
e. Edge Bevel: Provide manufacturer's standard beveled or square edges.
f. Top Edge Closures: Close top edges of doors with flush closures of same material as face sheets. Seal joints against water penetration.
g. Bottom Edges: Close bottom edges of doors with end closures or channels of same material as face sheets. Provide weep-hole openings in bottoms of exterior doors to permit moisture to escape.
h. Core: Vertical steel stiffener and filled with insulation as required to comply with Performance Requirements.

2. Frames:

a. Materials: Metallic-coated steel sheet, minimum thickness of 0.053 inch, with minimum A40 coating.
b. Construction: Thermally broken, full profile welded.

3. Exposed Finish: Prime.

2.5 INTERIOR CUSTOM HOLLOW-METAL DOORS AND FRAMES

A. Commercial Doors and Frames: NAAMM-HMMA 861; ANSI/SDI A250.4, Physical Performance Level A. At locations indicated in the Door and Frame Schedule to receive bronze cladding.

1. Basis-of-Design Product: Subject to compliance with requirement, provide **Forms+Surfaces; Classic Doors** or comparable product.

2. Doors:

a. Type: As indicated in the Door and Frame Schedule.

1) Provide applied formed bronze decorative molding applied to face of door in shape and configuration indicated to simulate flat-panel stile and rail door.
2) Provide formed bronze glazing stops at doors indicated with glazed lites.

b. Thickness: 1-3/4 inches.
c. Face: Bronze sheet, minimum thickness of 0.040 inch.
d. Edge Construction: Continuously welded with no visible seam.
e. Core: Steel stiffened.
f. Fire-Rated Core: Manufacturer's standard vertical steel stiffener core for fire-rated doors.

3. Frames:

a. Materials: Uncoated steel sheet, minimum thickness of 0.053 inch, except 0.067 inch for openings exceeding 4 feet wide. Clad steel frame with bronze as specified in Section 05 75 00 “Decorative Formed Metal.”
b. Sidelite and Transom Frames: Fabricated from same material as adjacent door frame.

c. Construction: Full profile welded.

2.6 BORROWED LITES

A. Fabricate of uncoated steel sheet, minimum thickness of 0.053 inch.

B. Construction: Full profile welded.

C. Fabricate in one piece except where handling and shipping limitations require multiple sections. Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of metal of same or greater thickness as metal as frames.

D. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.

2.7 HOLLOW-METAL PANELS

A. Provide hollow-metal panels of same materials, construction, and finish as adjacent door assemblies.

2.8 FRAME ANCHORS

A. Jamb Anchors:

1. Type: Anchors of minimum size and type required by applicable door and frame standard, and suitable for performance level indicated.
2. Quantity: Minimum of three anchors per jamb, with one additional anchor for frames with no floor anchor. Provide one additional anchor for each 24 inches of frame height above 7 feet.
3. Postinstalled Expansion Anchor: Minimum 3/8-inch-diameter bolts with expansion shields or inserts, with manufacturer's standard pipe spacer.

B. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor.

C. Material: ASTM A879/A879M, Commercial Steel (CS), 04Z coating designation; mill phosphatized.

1. For anchors built into exterior walls, steel sheet complying with ASTM A1008/A1008M or ASTM A1011/A1011M; hot-dip galvanized in accordance with ASTM A153/A153M, Class B.

2.9 MATERIALS

A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.

B. Cold-Rolled Steel Sheet: ASTM A1008/A1008M, Commercial Steel (CS), Type B; suitable for exposed applications.

C. Hot-Rolled Steel Sheet: ASTM A1011/A1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.

D. Metallic-Coated Steel Sheet: ASTM A653/A653M, Commercial Steel (CS), Type B.

E. Bronze Sheet: ASTM B36/B36M, Alloy UNS C28000 (muntz metal, 60 percent copper).

F. Inserts, Bolts, and Fasteners: Hot-dip galvanized in accordance with ASTM A153/A153M.

G. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hollow-metal frames of type indicated.

H. Mineral-Fiber Insulation: ASTM C665, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively; passing ASTM E136 for combustion characteristics.

I. Glazing: Comply with requirements in Section 08 80 00 "Glazing."

2.10 FABRICATION

A. Hollow-Metal Frames: Fabricate in one piece except where handling and shipping limitations require multiple sections. Where frames are fabricated in sections, provide alignment plates or angles at each joint, fabricated of metal of same or greater thickness as frames.

1. Sidelite and Transom Bar Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame. Fasten members at crossings and to jambs by welding.
2. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
3. Door Silencers: Except on weather-stripped frames, drill stops to receive door silencers as follows. Keep holes clear during construction.

    a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
    b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.

B. Hardware Preparation: Factory prepare hollow-metal doors and frames to receive templated mortised hardware, and electrical wiring; include cutouts, reinforcement, mortising, drilling, and tapping in accordance with ANSI/SDI A250.6, the Door Hardware Schedule, and templates.

1. Reinforce doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.
2. Comply with BHMA A156.115 for preparing hollow-metal doors and frames for hardware.

C. Glazed Lites: Provide stops and moldings around glazed lites where indicated. Form corners of stops and moldings with mitered hairline joints.

1. Provide stops and moldings flush with face of door, and with square stops unless otherwise indicated.

2. Multiple Glazed Lites: Provide fixed and removable stops and moldings so that each glazed lite is capable of being removed independently.
3. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames. Provide loose stops and moldings on inside of hollow-metal doors and frames.
4. Coordinate rabbet width between fixed and removable stops with glazing and installation types indicated.
5. Provide stops for installation with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches o.c. and not more than 2 inches o.c. from each corner.

2.11 STEEL FINISHES

A. Prime Finish: Clean, pretreat, and apply manufacturer's standard primer.

1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with ANSI/SDI A250.10; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.

2.12 COPPER-ALLOY FINISHES

A. Lacquered Hand-Rubbed Finish: M31-M34-O6x (Mechanical Finish: directionally textured, fine satin; Mechanical Finish: directionally textured, hand rubbed; Coating: clear, organic, air dried, as specified below).

1. Clear, Organic Coating: Lacquer specified for copper alloys, applied by air spray in two coats per manufacturer's written instructions, with interim drying, to a total thickness of 1 mil.

PART 3 - EXECUTION

3.1 PREPARATION

A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces. Touch up factory-applied finishes where spreaders are removed.

B. Drill and tap doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.

3.2 INSTALLATION

A. Install hollow-metal doors and frames plumb, rigid, properly aligned, and securely fastened in place. Comply with approved Shop Drawings and with manufacturer's written instructions.

B. Hollow-Metal Frames: Comply with ANSI/SDI A250.11 and NAAMM-HMMA 840 as applicable.

1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces without damage to completed Work.

    a. Where frames are fabricated in sections, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces. Touch-up finishes.
    b. Install frames with removable stops located on secure side of opening.

2. Fire-Rated Openings: Install frames in accordance with NFPA 80.
3. Floor Anchors: Secure with postinstalled expansion anchors.

    a. Floor anchors may be set with power-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.

4. Solidly pack mineral-fiber insulation inside frames.
5. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with grout or mortar.
6. In-Place Concrete or Masonry Construction: Secure frames in place with postinstalled expansion anchors. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
7. Installation Tolerances: Adjust hollow-metal frames to the following tolerances:

    a. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
    b. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
    c. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
    d. Plumbness: Plus or minus 1/16 inch, measured at jambs at floor.

C. Hollow-Metal Doors: Fit and adjust hollow-metal doors accurately in frames, within clearances specified below.

1. Non-Fire-Rated Steel Doors: Comply with ANSI/SDI A250.8 and NAAMM-HMMA 841 and NAAMM-HMMA guide specification as indicated.
2. Fire-Rated Doors: Install doors with clearances in accordance with NFPA 80.
3. Smoke-Control Doors: Install doors in accordance with NFPA 105.

D. Glazing: Comply with installation requirements in Section 088000 "Glazing" and with hollow-metal manufacturer's written instructions.

3.3 FIELD QUALITY CONTROL

A. Inspection Agency: Owner will engage a qualified inspector to perform inspections and to furnish reports to Architect.

B. Inspections:

1. Fire-Rated Door Inspections: Inspect each fire-rated door in accordance with NFPA 80, Section 5.2.

2. Egress Door Inspections: Inspect each door equipped with panic hardware, each door equipped with fire exit hardware, each door located in an exit enclosure, each electrically controlled egress door, and each door equipped with special locking arrangements in accordance with NFPA 101, Section 7.2.1.15.

C. Repair or remove and replace installations where inspections indicate that they do not comply with specified requirements.

D. Reinspect repaired or replaced installations to determine if replaced or repaired door assembly installations comply with specified requirements.

E. Prepare and submit separate inspection report for each fire-rated door assembly indicating compliance with each item listed in NFPA 80 and NFPA 101.

3.4 REPAIR

A. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.

B. Metallic-Coated Surface Touchup: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.

C. Clean copper alloys according to metal finisher's written instructions in a manner that leaves an undamaged and uniform finish matching approved Sample.

END OF SECTION

SECTION 08 14 16 - FLUSH WOOD DOORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Five-ply flush wood veneer-faced doors and transom panels for transparent finish.
2. Five-ply flush wood doors for opaque finish.
3. Factory finishing flush wood doors.
4. Fire-rated wood door frames.
5. Factory fitting flush wood doors to frames and factory machining for hardware.

B. Related Requirements:

1. Section 06 40 23 “Interior Architectural Woodwork” for non-fire-rated wood frames and jambs.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product, including the following:

1. Door core materials and construction.
2. Door edge construction
3. Door face type and characteristics.
4. Door trim for openings.
5. Door frame construction.
6. Factory-machining criteria.
7. Factory- finishing specifications.

B. Sustainable Design Submittals:

1. Chain-of-Custody Certificates: For certified wood products. Include statement of costs.
2. Chain-of-Custody Qualification Data: For manufacturer and vendor.
3. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting materials.
4. Laboratory Test Reports: For composite wood products, indicating compliance with requirements for low-emitting materials.

C. Shop Drawings: Indicate location, size, and hand of each door; elevation of each type of door; construction details not covered in Product Data; and the following:

1. Door schedule indicating door and frame location, type, size, fire protection rating, and swing.
2. Door elevations, dimension and locations of hardware, lite and louver cutouts, and glazing thicknesses.
3. Details of frame for each frame type, including dimensions and profile.

4. Details of electrical raceway and preparation for electrified hardware, access control systems, and security systems.
5. Dimensions and locations of blocking for hardware attachment.
6. Dimensions and locations of mortises and holes for hardware.
7. Clearances and undercuts.
8. Requirements for veneer matching.
9. Doors to be factory finished and application requirements.

D. Samples for Verification:

1. Factory finishes applied to actual door face materials, approximately 8 by 10 inches, for each material and finish.

1.3 INFORMATIONAL SUBMITTALS

A. Sample Warranty: For special warranty.

1.4 CLOSEOUT SUBMITTALS

A. Special warranties.

B. Record Documents: For fire-rated doors, list of door numbers and applicable room name and number to which door accesses.

1.5 QUALITY ASSURANCE

A. Certified Wood: Provide an invoice including vendor's chain-of-custody number, product cost, and entity being invoiced.

B. Vendor Qualifications: A vendor that is certified for chain of custody by an FSC-accredited certification body.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Comply with requirements of referenced standard and manufacturer's written instructions.

B. Package doors individually in cardboard cartons, and wrap bundles of doors in plastic sheeting.

C. Mark each door on bottom rail with opening number used on Shop Drawings.

1.7 FIELD CONDITIONS

A. Environmental Limitations:

1. Do not deliver or install doors until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, and HVAC system is operating and maintaining temperature

and relative humidity at levels designed for building occupants for the remainder of construction period.

1.8 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace doors and frames that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Delamination of veneer.
b. Warping (bow, cup, or twist) more than 1/4 inch in a 42-by-84-inch section.
c. Telegraphing of core construction in face veneers exceeding 0.01 inch in a 3-inch span.

2. Warranty also includes installation and finishing that may be required due to repair or replacement of defective doors and frames.
3. Warranty Period for Solid-Core Interior Doors: Life of installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations:

1. Obtain flush wood doors from single manufacturer.
2. Obtain skins for doors with transparent finish from same wood veneer supplier as stile and rail wood paneling specified in Section 06 42 14 “Stile and Rail Wood Paneling.”

2.2 PERFORMANCE REQUIREMENTS

A. Fire-Rated Wood Door and Frame Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated on Drawings, based on testing at positive pressure in accordance with UL 10C or NFPA 252.

1. Oversize Fire-Rated Door Assemblies: For units exceeding sizes of tested assemblies, provide certification by a qualified testing agency that doors comply with standard construction requirements for tested and labeled fire-rated door assemblies except for size.

B. Smoke- and Draft-Control Door Assemblies: Listed and labeled for smoke and draft control by a qualified testing agency acceptable to authorities having jurisdiction, based on testing in accordance with UL 1784 and installed in compliance with NFPA 105.

2.3 FLUSH WOOD DOORS AND FRAMES, GENERAL

A. Quality Standard: In addition to requirements specified, comply with ANSI/WDMA I.S. 1A.

B. Regional Materials: To the extent required to comply with the minimum criteria specified in Section 01 81 13.14 “Sustainable Design Requirements,” manufacture wood doors within 100 miles of Project site from materials that have been extracted, harvested, or recovered, as well as manufactured, within 100 miles of Project site.

C. Certified Wood: Certify wood doors as "FSC Pure" or "FSC Mixed Credit" in accordance with FSC STD-01-001 and FSC STD-40-004.

D. Adhesives: Use adhesives that meet the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

E. Composite Wood Products: Verify products are made using ultra-low-emitting formaldehyde resins, as defined in the California Air Resources Board's "Airborne Toxic Control Measure to Reduce Formaldehyde Emissions from Composite Wood Products," or are made with no added formaldehyde.

2.4 SOLID-CORE FIVE-PLY FLUSH WOOD VENEER-FACED DOORS AND TRANSOM PANELS FOR TRANSPARENT FINISH

A. Interior Doors, Solid-Core Five-Ply Veneer-Faced:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Lambton Doors.
    b. Masonite Architectural.
    c. Oshkosh Door Company.
    d. VT Industries, Inc.

2. Performance Grade by Location:

    a. ANSI/WDMA I.S. 1A Extra Heavy Duty: Courtrooms, public toilets, janitor's closets, assembly spaces, and exits.
    b. ANSI/WDMA I.S. 1A Heavy Duty: Typical unless noted otherwise.

3. ANSI/WDMA I.S. 1A Grade: Premium.
4. Faces: Single-ply wood veneer not less than 1/50 inch thick.

    a. Flitch, Species and Cut: As preselected and indicated in Finish Schedule.
    b. Match between Veneer Leaves: Book match.
    c. Assembly of Veneer Leaves on Door Faces: Center-balance match.
    d. Pair and Set Match: Provide for doors hung in same opening or separated only by mullions.
    e. Room Match:

1) Match door faces within each separate room or area of building. Corridor-door faces do not need to match where they are separated by 10 feet or more.

f. Transom Match: End match.

5. Exposed Vertical Edges: Applied wood-veneer edges of same species as faces and covering edges of faces - Architectural Woodwork Standards edge Type B.

a. Fire-Rated Single Doors: Provide edge construction with intumescent seals concealed by outer stile. Comply with specified requirements for exposed vertical edges.
b. Fire-Rated Pairs of Doors:

1) Provide fire-retardant stiles that are listed and labeled for applications indicated without formed-steel edges and astragals. Provide stiles with concealed intumescent seals. Comply with specified requirements for exposed edges.

c. Mineral-Core Doors: At hinge stiles, provide laminated-edge construction with improved screw-holding capability and split resistance. Comply with specified requirements for exposed edges.

1) Screw-Holding Capability: 550 lbf in accordance with WDMA T.M. 10.

6. Core for Non-Fire-Rated Doors:

a. ANSI A208.1, Grade LD-2 particleboard.

1) Provide doors with WDMA I.S. 10 structural-composite-lumber cores instead of particleboard cores for doors scheduled to receive exit devices in Section 08 71 00 "Door Hardware."

7. Core for Fire-Rated Doors: As required to achieve fire-protection rating indicated on Drawings.

a. Blocking for Mineral-Core Doors: Provide composite blocking with improved screw-holding capability approved for use in doors of fire-protection ratings indicated on Drawings as needed to eliminate through-bolting hardware.

8. Construction: Five plies, hot-pressed bonded (vertical and horizontal edging is bonded to core), with entire unit abrasive planed before veneering.

2.5 SOLID-CORE FIVE-PLY FLUSH WOOD DOORS FOR OPAQUE FINISH

A. Interior Doors, Solid-Core Five-Ply:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Lambton Doors.
b. Masonite Architectural.

c. Oshkosh Door Company.
d. VT Industries, Inc.

2. Performance Grade by Location:

a. ANSI/WDMA I.S. 1A Extra Heavy Duty: Courtrooms, public toilets, janitor's closets, assembly spaces, and exits.
b. ANSI/WDMA I.S. 1A Heavy Duty: Typical unless noted otherwise.

3. ANSI/WDMA I.S. 1A Grade: Premium.
4. Faces: MDO.

a. Apply MDO to standard-thickness, closed-grain, hardwood face veneers or directly to high-density hardboard crossbands.
b. MDF Faces: ANSI A208.2, Grade 150 or Grade 160.

5. Exposed Vertical and Top Edges: Any closed-grain hardwood.

a. Fire-Rated Single Doors: Provide edge construction with intumescent seals concealed by outer stile. Comply with specified requirements for exposed vertical edges.
b. Fire-Rated Pairs of Doors:

1) Provide fire-retardant stiles that are listed and labeled for applications indicated without formed-steel edges and astragals. Provide stiles with concealed intumescent seals. Comply with specified requirements for exposed edges.

c. Mineral-Core Doors: At hinge stiles, provide laminated-edge construction with improved screw-holding capability and split resistance. Comply with specified requirements for exposed edges.

1) Screw-Holding Capability: 550 lbf in accordance with WDMA T.M. 10.

6. Core for Non-Fire-Rated Doors:

a. ANSI A208.1, Grade LD-2 particleboard.

1) Provide doors with glued-wood-stave cores instead of particleboard cores for doors scheduled to receive exit devices in Section 087100 "Door Hardware."

7. Core for Fire-Rated Doors: As required to achieve fire-protection rating indicated on Drawings.

a. Blocking for Mineral-Core Doors: Provide composite blocking with improved screw-holding capability approved for use in doors of fire-protection ratings indicated on Drawings as needed to eliminate through-bolting hardware.

8. Construction: Five plies, hot-pressed bonded (vertical and horizontal edging is bonded to core), with entire unit abrasive planed before veneering.

2.6 LIGHT FRAMES AND LOUVERS

A. Wood Beads for Light Openings in Wood Doors: Provide manufacturer's standard wood beads unless otherwise indicated.

1. Wood Species: Same species as door faces.
2. Profile: Flush rectangular beads.
3. At wood-core doors with 20-minute fire-protection ratings, provide wood beads and metal glazing clips approved for such use.

B. Wood-Veneered Beads for Light Openings in Fire-Rated Doors: Manufacturer's standard wood-veneered noncombustible beads matching veneer species of door faces and approved for use in doors of fire-protection rating indicated on Drawings. Include concealed metal glazing clips where required for opening size and fire-protection rating indicated.

2.7 FABRICATION

A. Factory fit doors to suit frame-opening sizes indicated.

1. Comply with clearance requirements of referenced quality standard for fitting unless otherwise indicated.
2. Comply with NFPA 80 requirements for fire-rated doors.

B. Factory machine doors for hardware that is not surface applied.

1. Locate hardware to comply with DHI-WDHS-3.
2. Comply with final hardware schedules, door frame Shop Drawings, ANSI/BHMA-156.115-W, and hardware templates.
3. Coordinate with hardware mortises in metal frames, to verify dimensions and alignment before factory machining.
4. For doors scheduled to receive electrified locksets, provide factory-installed raceway and wiring to accommodate specified hardware.

C. Transom and Side Panels:

1. Fabricate matching panels with same construction, exposed surfaces, and finish as specified for associated doors.
2. Finish bottom edges of transoms and top edges of rabbeted doors same as door stiles.
3. Fabricate door and transom panels with full-width, solid-lumber, rabbeted, meeting rails.
4. Provide factory-installed spring bolts for concealed attachment into jambs of metal door frames.

D. Openings: Factory cut and trim openings through doors.

1. Light Openings: Trim openings with moldings of material and profile indicated.
2. Glazing: Factory install glazing in doors indicated to be factory finished. Comply with applicable requirements in Section 08 80 00 "Glazing."

2.8 FACTORY FINISHING

A. Comply with referenced quality standard for factory finishing.

1. Complete fabrication, including fitting doors for openings and machining for hardware that is not surface applied, before finishing.
2. Finish faces, all four edges, edges of cutouts, and mortises.
3. Stains and fillers may be omitted on top and bottom edges, edges of cutouts, and mortises.

B. Factory finish doors.

C. Transparent Finish:

1. ANSI/WDMA I.S. 1A Grade: Premium.
2. ANSI/WDMA I.S. 1A TR-6 Catalyzed Polyurethane.
3. Staining: Clear finish, no stain.
4. Sheen: 20 percent.

D. Opaque Finish:

1. ANSI/WDMA I.S. 1A Grade: Premium.
2. ANSI/WDMA I.S. 1A OP-6 Catalyzed Polyurethane.
3. Color and Sheen: As preselected and indicated in Finish Schedule.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine doors and installed door frames, with Installer present, before hanging doors.

1. Verify that installed frames comply with indicated requirements for type, size, location, and swing characteristics and have been installed with level heads and plumb jambs.
2. Reject doors with defects.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Hardware: For installation, see Section 087100 "Door Hardware."

B. Install doors and frames to comply with manufacturer's written instructions and referenced quality standard, and as indicated.

C. Install frames level, plumb, true, and straight.

1. Shim as required with concealed shims. Install level and plumb to a tolerance of 1/8 inch in 96 inches.
2. Anchor frames to anchors or blocking built in or directly attached to substrates.

a. Secure with countersunk, concealed fasteners and blind nailing.
b. Use fine finishing nails or finishing screws for exposed fastening, countersunk and filled flush with woodwork.

1) For factory-finished items, use filler matching finish of items being installed.

3. Install fire-rated doors and frames in accordance with NFPA 80.
4. Install smoke- and draft-control doors in accordance with NFPA 105.

D. Factory-Fitted Doors: Align in frames for uniform clearance at each edge.

E. Factory-Finished Doors: Restore finish before installation if fitting or machining is required at Project site.

3.3 FIELD QUALITY CONTROL

A. Inspection Agency: Owner will engage a qualified inspector to perform inspections and to furnish reports to Architect.

B. Inspections:

1. Fire-Rated Door Inspections: Inspect each fire-rated door in accordance with NFPA 80, Section 5.2.
2. Egress Door Inspections: Inspect each door equipped with panic hardware, each door equipped with fire exit hardware, each door located in an exit enclosure, each electrically controlled egress door, and each door equipped with special locking arrangements in accordance with NFPA 101, Section 7.2.1.15.

C. Repair or remove and replace installations where inspections indicate that they do not comply with specified requirements.

D. Reinspect repaired or replaced installations to determine if replaced or repaired door assembly installations comply with specified requirements.

E. Prepare and submit separate inspection report for each fire-rated door assembly indicating compliance with each item listed in NFPA 80 and NFPA 101.

3.4 ADJUSTING

A. Operation: Rehang or replace doors that do not swing or operate freely.

B. Finished Doors: Replace doors that are damaged or that do not comply with requirements. Doors may be repaired or refinished if Work complies with requirements and shows no evidence of repair or refinishing.

END OF SECTION

This page is intentionally left blank.

SECTION 08 14 33 - STILE AND RAIL WOOD DOORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Interior stile and rail wood doors.
2. Interior fire-rated stile and rail wood doors.
3. Fire-rated wood door frames.
4. Factory fitting stile and rail wood doors to frames and factory machining for hardware.
5. Factory priming and finishing.

B. Related Requirements:

1. Section 05 75 00 “Decorative Formed Metal” for formed metal cladding of stile and rail wood doors, where indicated.
2. Section 06 40 23 “Interior Architectural Woodwork” for non-fire-rated wood frames and jambs.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product, including the following:

1. Details of construction and glazing.
2. Door frame construction.
3. Factory-machining criteria.
4. Factory- finishing specifications.

B. Sustainable Design Submittals:

1. Chain-of-Custody Certificates: For certified wood products. Include statement of costs.
2. Chain-of-Custody Qualification Data: For manufacturer and vendor.
3. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting materials.
4. Laboratory Test Reports: For composite wood products, indicating compliance with requirements for low-emitting materials.

C. Shop Drawings: Indicate location, size, and hand of each door; elevation of each type of door; construction details not covered in Product Data, including those for stiles, rails, panels, and moldings (sticking); and other pertinent data, including the following:

1. Door schedule indicating door and frame location, type, size, fire protection rating, and swing.
2. Door elevations, dimensions and location of hardware, lite locations, and glazing thickness.
3. Details of frame for each frame type, including dimensions and profile.
4. Details of electrical raceway and preparation for electrified hardware, access control systems, and security systems.
5. Dimensions and locations of mortises and holes for hardware.
6. Clearances and undercuts.
7. Requirements for veneer matching.
8. Doors to be factory finished and application requirements.

D. Samples for Verification:

1. Factory finishes applied to actual door face materials, approximately 8 by 10 inches, for each material and finish. For each wood species and transparent finish, provide set of three Samples showing typical range of color and grain to be expected in finished Work.

1.4 INFORMATIONAL SUBMITTALS

A. Sample Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS.

A. Special warranties.

B. Record Documents: For fire-rated doors, list of door numbers and applicable room name and number to which door accesses.

1.6 QUALITY ASSURANCE

A. Certified Wood: Provide an invoice including vendor's chain-of-custody number, product cost, and entity being invoiced.

B. Vendor Qualifications: A vendor that is certified for chain of custody by an FSC-accredited certification body.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Comply with requirements of referenced standard and manufacturer's written instructions.

B. Package doors individually in opaque plastic bags or cardboard cartons.

C. Mark each door on bottom rail with opening number used on Shop Drawings.

1.8 FIELD CONDITIONS

A. Environmental Limitations:

1. Do not deliver or install doors until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and HVAC system is operating and maintaining temperature and relative humidity levels designed for building occupants for the remainder of construction period.

1.9 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace doors and frames that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Delamination of veneer.
b. Warping (bow, cup, or twist) more than 1/4 inch in a 42-by-84-inch section.
c. Telegraphing of core construction in face veneers exceeding 0.01 inch in a 3-inch span.

2. Warranty shall also include installation and finishing that may be required due to repair or replacement of defective doors and frames.
3. Warranty shall be in effect during specified period of time from date of Substantial Completion.
4. Warranty Period for Interior Doors: Life of installation.
5. Insulating Glass Vision Panels: Five years.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations:

1. Obtain each type of stile and rail wood door from single manufacturer.
2. Obtain custom stile and rail wood doors at courtrooms from same fabricator as work in Section 06 42 14 "Stile and Rail Wood Paneling."

2.2 PERFORMANCE REQUIREMENTS

A. Fire-Rated Wood Door and Frame Assemblies: Complying with NFPA 80 that are listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction for fire-protection ratings indicated on Drawings, based on testing at positive pressure according to UL 10C or NFPA 252.

1. Oversize Fire-Rated Door Assemblies: For units exceeding sizes of tested assemblies, provide certification by a qualified testing agency that doors comply with standard construction requirements for tested and labeled fire-rated door assemblies except for size.

B. Smoke- and Draft-Control Door Assemblies: Listed and labeled for smoke and draft control by a qualified testing agency acceptable to authorities having jurisdiction, based on testing according to UL 1784 and installed in compliance with NFPA 105.

2.3 MATERIALS

A. Use only materials that comply with referenced standards and other requirements specified.

1. Assemble interior doors, including components, with either dry-use or wet-use adhesives complying with ASTM D5572 for finger joints and with ASTM D5751 for joints other than finger joints.

B. Regional Materials: To the extent required to comply with the minimum criteria specified in Section 01 81 13.14 “Sustainable Design Requirements,” manufacture wood doors within 100 miles of Project site from materials that have been extracted, harvested, or recovered, as well as manufactured, within 100 miles of Project site.

C. Certified Wood: Certify wood doors as "FSC Pure" or "FSC Mixed Credit" in accordance with FSC STD-01-001 and FSC STD-40-004.

D. Adhesives: Use adhesives that meet the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

E. Composite Wood Products: Verify products are made using ultra-low-emitting formaldehyde resins, as defined in the California Air Resources Board's "Airborne Toxic Control Measure to Reduce Formaldehyde Emissions from Composite Wood Products," or are made with no added formaldehyde.

F. Panel Products: Any of the following unless otherwise indicated:

1. Particleboard: ANSI A208.1, Grade M-2.
2. Medium-density fiberboard (MDF), complying with ANSI A208.2, Grade 130.
3. Hardboard complying with ANSI A135.4.
4. Veneer-core plywood.

G. Safety Glass: Provide products complying with testing requirements in 16 CFR 1201, for Category II materials, unless those of Category I are expressly indicated and permitted.

2.4 INTERIOR STILE AND RAIL WOOD DOORS FOR TRANSPARENT AND OPAQUE FINISH

A. Interior Stile and Rail Wood Doors: Interior custom doors complying with AWI, AWMAC, and WI's Architectural Woodwork Standards for courtroom doors and WDMA I.S. 6A otherwise and with other requirements specified.

1. For doors complying with WDMA I.S. 6A:

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) Karona by JELD-WEN.

2) Masonite Architectural.
3) VT Industries, Inc.

2. Performance Grade:

a. WDMA I.S. 6A: Heavy Duty unless noted otherwise.
b. Architectural Woodwork Standards: Premium.

3. Panel Designs: Indicated on Drawings. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.
4. Finish: Transparent and opaque, as indicated on Finish Schedule.
5. Wood Species and Cut for Transparent Finish: As preselected and indicated in Finish Schedule.
6. Door Construction for Transparent Finish:

a. Stile and Rail Construction:

1) Veneered, structural composite lumber or veneered, edge- and end-glued clear lumber. Select veneers for similarity of grain and color, and arrange for optimum match between adjacent pieces. Use veneers not less than 1/16 inch thick.

b. Flat-Panel Construction: Veneered, wood-based panel product.

7. Door Construction for Opaque Finish:

a. Stile and Rail Construction:

1) Veneered, structural composite lumber or veneered edge- and end-glued lumber.

b. Flat-Panel Construction: Medium-density fiberboard.

8. Stile and Rail Widths: Unless noted otherwise on Drawings provide the following:

a. Stiles, Top and Intermediate Rails: 4-1/2 inches.
b. Bottom Rails: 10 inches.

9. Flat-Panel Thickness: 1/2 inch.
10. Molding Profile (Sticking): Match Historic Courtroom.
11. Glass: Uncoated, clear, fully tempered float glass, 6.0 mm thick, complying with Section 088000 "Glazing."
12. Mark, label, or otherwise identify stile and rail wood doors as complying with WDMA I.S. 6A and grade specified.

2.5 INTERIOR FIRE-RATED STILE AND RAIL WOOD DOORS

A. 20-Minute, Interior Fire-Rated Stile and Rail Wood Doors: Fire-rated (20-minute rating) doors complying with AWI, AWMAC, and WI's Architectural Woodwork Standards for courtroom doors and WDMA I.S. 6A otherwise and with other requirements specified.

1. For doors complying with WDMA I.S. 6A:

    a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

        1) Karona by JELD-WEN.
        2) Masonite Architectural.
        3) VT Industries, Inc.

2. Performance Grade:

    a. WDMA I.S. 6A: Heavy Duty unless noted otherwise.
    b. Architectural Woodwork Standards: Premium at courtroom doors.

3. Panel Designs: Match non-fire-rated stile and rail wood doors.
4. Finish: Match non-fire-rated stile and rail wood doors.
5. Wood Species and Cut for Transparent Finish: Match non-fire-rated stile and rail wood doors.
6. Door Construction for Transparent Finish: Match non-fire-rated stile and rail wood doors except as follows:

    a. Edge Construction for Fire-Rated Single Doors: Provide edge construction with intumescent seals concealed by outer stile. Comply with specified requirements for exposed edges.
    b. Edge Construction for Fire-Rated Pairs of Doors:

        1) Provide fire-retardant stiles that are listed and labeled for applications indicated without formed-steel edges and astragals. Provide stiles with concealed intumescent seals. Comply with specified requirements for exposed edges.

7. Stile and Rail Widths: Match non-fire-rated stile and rail wood doors
8. Molding Profile (Sticking): Match non-fire-rated stile and rail wood doors.
9. Mark, label, or otherwise identify stile and rail wood doors as complying with WDMA I.S. 6A and grade specified.

B. 45-Minute, Interior Fire-Rated Stile and Rail Wood Doors: Fire-rated (45-minute rating) doors complying with AWI, AWMAC, and WI's Architectural Woodwork Standards and with other requirements specified.

1. For doors complying with WDMA I.S. 6A:

    a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

        1) Karona by JELD-WEN.
        2) Masonite Architectural.
        3) VT Industries, Inc.

2. Performance Grade:

    a. WDMA I.S. 6A: Heavy Duty unless noted otherwise.
    b. Architectural Woodwork Standards: Premium at courtroom doors.

1. Panel Designs: Match non-fire-rated stile and rail wood doors.
2. Finish: Match non-fire-rated stile and rail wood doors.
3. Wood Species and Cut for Transparent Finish: Match non-fire-rated stile and rail wood doors.
4. Door Construction for Transparent Finish: Match non-fire-rated stile and rail wood doors except as follows:
5. Interior Fire-Rated Door Construction: 1-3/4-inch-thick, edged and veneered mineral-core stiles and rails and 1-1/8-inch-thick, veneered mineral-core raised panels.
6. Edge Construction for Fire-Rated Single Doors: Provide edge construction with intumescent seals concealed by outer stile. Comply with specified requirements for exposed edges.

    a. At hinge stiles, provide laminated-edge construction with improved screw-holding capability and split resistance. Comply with specified requirements for exposed edges.

        1) Screw-Holding Capability: 550 lbf according to WDMA T.M. 10.

7. Edge Construction for Fire-Rated Pairs of Doors:

    a. Fire-Retardant Stiles: Provide fire-retardant stiles that are listed and labeled for applications indicated without formed-steel edges and astragals. Provide stiles with concealed intumescent seals. Comply with specified requirements for exposed edges.

        1) At hinge stiles, provide laminated-edge construction with improved screw-holding capability and split resistance. Comply with specified requirements for exposed edges.

            a) Screw-Holding Capability: 550 lbf according to WDMA T.M. 10.

8. Stile and Rail Widths: Match non-fire-rated stile and rail wood doors
9. Molding Profile (Sticking): Match non-fire-rated stile and rail wood doors.
10. Mark, label, or otherwise identify stile and rail wood doors as complying with WDMA I.S. 6A and grade specified.

2.6 STILE AND RAIL WOOD DOOR FABRICATION

A. Factory fit doors to suit frame-opening sizes indicated, with the following uniform clearances and bevels unless otherwise indicated:

1. Clearances:

    a. Provide 1/8 inch at heads, jambs, and between pairs of doors.
    b. Provide 1/2 inch from bottom of door to top of decorative floor finish or covering.
    c. Where threshold is shown on Drawings or scheduled, provide not more than 3/8 inch from bottom of door to top of threshold.
    d. Comply with NFPA 80 requirements for fire-rated doors.

2. Bevel non-fire-rated doors 1/8 inch in 2 inches at lock and hinge edges.
3. Bevel fire-rated doors 1/8 inch in 2 inches on lock edge; trim stiles and rails only to extent permitted by labeling agency.

B. Fabricate stile and rail wood doors in sizes indicated for field fitting.

C. Factory machine doors for hardware that is not surface applied.

1. Locate hardware to comply with DHI-WDHS-3.
2. Comply with final hardware schedules, door frame Shop Drawings, BHMA-156.115-W, and hardware templates.
3. For doors scheduled to receive electrified locksets, provide factory-installed raceway and wiring to accommodate specified hardware.
4. Coordinate measurements of hardware mortises in metal frames to verify dimensions and alignment before factory machining.

D. Glazed Openings:

1. Trim openings indicated for glazing with solid-wood moldings, with one side removable. Miter wood moldings at corner joints.
2. Factory install glazing in doors, complying with Section 08 80 00 "Glazing." Install glass using manufacturer's standard elastomeric glazing sealant complying with ASTM C920. Secure glass in place with removable wood moldings. Miter wood moldings at corner joints.

E. Transom and Side Panels:

1. Fabricate matching panels with same construction, exposed surfaces, and finish as specified for associated doors.
2. Finish bottom edges of transoms and top edges of rabbeted doors same as door stiles.
3. Fabricate door and transom panels with full-width, solid-lumber, rabbeted, meeting rails.
4. Provide factory-installed spring bolts for concealed attachment into jambs of metal door frames.

2.7 FACTORY FINISHING

A. Comply with referenced quality standard for factory finishing.

1. Complete fabrication, including fitting doors for openings and machining for hardware that is not surface applied, before finishing.
2. Finish faces, all four edges, edges of cutouts, and mortises.
3. Stains and fillers may be omitted on top and bottom edges, edges of cutouts, and mortises.

B. Factory finish doors.

C. Transparent Finish:

1. WDMA I.S. 6A Grade: Premium.
2. Finish:

    a. WDMA I.S. 6A TR-6 Catalyzed Polyurethane.

3. Staining: Clear, no stain.
4. Sheen: Satin.

D. Opaque Finish:

1. WDMA I.S. 6A Grade: Premium.
2. Finish:

    a. WDMA I.S. 6A OP-6 Catalyzed Polyurethane.

3. Color: As preselected and indicated in Finish Schedule.
4. Sheen: Semigloss.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine doors and installed door frames, with Installer present, before hanging doors.

1. Verify that installed frames comply with indicated requirements for type, size, location, and swing characteristics and have been installed with level heads and plumb jambs.
2. Reject doors with defects.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Hardware: For installation, see Section 087100 "Door Hardware."

B. Install doors and frames to comply with manufacturer's written instructions and referenced quality standard, and as indicated.

1. Install fire-rated door frames according to NFPA 80.

    a. Install frames level, plumb, true, and straight.

        1) Shim as required with concealed shims. Install level and plumb to a tolerance of 1/8 inch in 96 inches.

    b. Anchor frames to anchors or blocking built in or directly attached to substrates.

        1) Secure with countersunk, concealed fasteners and blind nailing.
        2) Use fine finishing nails or finishing screws for exposed fastening, countersunk and filled flush with woodwork.

    c. For shop-finished items, use filler matching finish of items being installed.

2. Install fire-rated doors according to NFPA 80.
3. Install smoke- and draft-control doors according to NFPA 105.

C. Factory-Fitted Doors: Align in frames for uniform clearance at each edge.

D. Factory- Finished Doors: Restore finish before installation if fitting or machining is required at Project site.

3.3 FIELD QUALITY CONTROL

A. Inspection Agency: Owner will engage a qualified inspector to perform inspections and to furnish reports to Architect.

B. Inspections:

1. Fire-Rated Door Inspections: Inspect each fire-rated door in accordance with NFPA 80, Section 5.2.
2. Egress Door Inspections: Inspect each door equipped with panic hardware, each door equipped with fire exit hardware, each door located in an exit enclosure, each electrically controlled egress door, and each door equipped with special locking arrangements according to NFPA 101, Section 7.2.1.15.

C. Repair or remove and replace installations where inspections indicate that they do not comply with specified requirements.

D. Reinspect repaired or replaced installations to determine if replaced or repaired door installations comply with specified requirements.

E. Prepare and submit separate inspection report for each fire-rated door assembly indicating compliance with each item listed in NFPA 80 and NFPA 101.

3.4 ADJUSTING

A. Operation: Rehang or replace doors that do not swing or operate freely.

B. Finished Doors: Replace doors that are damaged or do not comply with requirements. Doors may be repaired or refinished if Work complies with requirements and shows no evidence of repair or refinishing.

END OF SECTION

SECTION 08 31 13 - ACCESS DOORS AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Access doors and frames.
2. Fire-rated access doors and frames.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, fire ratings, material descriptions, dimensions of individual components and profiles, and finishes.

B. Samples: For each type of access door and frame and for each finish specified, complete assembly minimum 6 by 6 inches in size.

1.3 CLOSEOUT SUBMITTALS

A. Record Documents: For fire-rated doors, list of applicable room name and number in which access door is located.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Rated Access Doors and Frames: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, according to NFPA 252 or UL 10B.

2.2 ACCESS DOORS AND FRAMES

A. Flush Access Doors with Exposed Flanges at Basement Level and Penthouse Level:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. ACUDOR Products, Inc.
b. Babcock-Davis.
c. J. L. Industries, Inc.; Activar Construction Products Group, Inc.

d. Karp Associates, Inc.
e. Larsen's Manufacturing Company.
f. Milcor; Hart & Cooley, Inc.
g. Nystrom, Inc.

2. Description: Face of door flush with frame, with exposed flange and concealed hinge.
3. Locations: Wall and ceiling.
4. Door Size: As indicated or as required to provide adequate access to equipment. Where not indicated, obtain approval of size and location from Architect.
5. Metallic-Coated Steel Sheet for Door: Nominal 0.064 inch, 16 gage, factory primed.
6. Latch and Lock: Cam latch, screwdriver operated.

B. Recessed Access Doors with Concealed Flanges at Level 01 through Level 05:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. ACUDOR Products, Inc.
b. Babcock-Davis.
c. J. L. Industries, Inc.; Activar Construction Products Group, Inc.
d. Karp Associates, Inc.
e. Larsen's Manufacturing Company.
f. Milcor; Hart & Cooley, Inc.
g. Nystrom, Inc.

2. Description: Door face recessed 5/8 inch for gypsum board infill; with concealed flange for gypsum board installation and concealed hinge.
3. Locations: Wall and ceiling.
4. Door Size: As indicated or as required to provide adequate access to equipment. Where not indicated, obtain approval of size and location from Architect.
5. Metallic-Coated Steel Sheet for Door: Nominal 0.064 inch, 16 gage, factory primed.
6. Latch and Lock: Cam latch, screwdriver operated.

2.3 FIRE-RATED ACCESS DOORS AND FRAMES

A. Fire-Rated, Flush Access Doors with Exposed Flanges at Basement Level and Penthouse Level:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. ACUDOR Products, Inc.
b. Babcock-Davis.
c. J. L. Industries, Inc.; Activar Construction Products Group, Inc.
d. Karp Associates, Inc.
e. Larsen's Manufacturing Company.
f. Milcor; Hart & Cooley, Inc.
g. Nystrom, Inc.

2. Description: Door face flush with frame, with a core of mineral-fiber insulation enclosed in sheet metal; with exposed flange, self-closing door, and concealed hinge.
3. Locations: Wall and ceiling.

4. Door Size: As indicated or as required to provide adequate access to equipment. Where not indicated, obtain approval of size and location from Architect.
5. Fire-Resistance Rating: Not less than that of adjacent construction.
6. Metallic-Coated Steel Sheet for Door: Nominal 0.040 inch, 20 gage, factory primed.
7. Latch and Lock: Self-latching door hardware, operated by knurled-knob with interior release.

B. Fire-Rated, Recessed Access Doors with Concealed Flanges at Level 01 through Level 05:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. ACUDOR Products, Inc.
   b. Babcock-Davis.
   c. J. L. Industries, Inc.; Activar Construction Products Group, Inc.
   d. Karp Associates, Inc.
   e. Milcor; Hart & Cooley, Inc.
   f. Nystrom, Inc.

2. Description: Door face flush with frame, uninsulated; with concealed flange for gypsum board installation, self-closing door, and concealed hinge.
3. Locations: Wall and ceiling.
4. Door Size: As indicated or as required to provide adequate access to equipment. Where not indicated, obtain approval of size and location from Architect.
5. Fire-Resistance Rating: Not less than that of adjacent construction.
6. Metallic-Coated Steel Sheet for Door: Nominal 0.040 inch, 20 gage, factory primed.
7. Latch and Lock: Self-closing, self-latching door hardware, operated by knurled-knob.

2.4 MATERIALS

A. Metallic-Coated Steel Sheet: ASTM A653/A653M, Commercial Steel (CS), Type B; with minimum G60 or A60 metallic coating.

B. Frame Anchors: Same material as door face.

C. Inserts, Bolts, and Anchor Fasteners: Hot-dip galvanized steel according to ASTM A153/A153M or ASTM F2329.

2.5 FABRICATION

A. General: Provide access door and frame assemblies manufactured as integral units ready for installation.

B. Metal Surfaces: For metal surfaces exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.

C. Doors and Frames: Grind exposed welds smooth and flush with adjacent surfaces. Furnish mounting holes, attachment devices and fasteners of type required to secure access doors to types of supports indicated.

1. For concealed flanges with drywall bead, provide edge trim for gypsum panels securely attached to perimeter of frames.

D. Recessed Access Doors: Form face of panel to provide recess for application of applied finish. Reinforce panel as required to prevent buckling. Provide access sleeves for each latch operator and install in holes cut through finish.

2.6 FINISHES

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

D. Painted Finishes: Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

1. Factory Primed: Apply manufacturer's standard, lead- and chromate-free, universal primer immediately after surface preparation and pretreatment.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with manufacturer's written instructions for installing access doors and frames.

3.3 FIELD QUALITY CONTROL

A. Inspection Agency: Owner will engage a qualified inspector to perform inspections and to furnish reports to Architect.

B. Inspections:

1. Fire-Rated Door Inspections: Inspect each fire-rated access door in accordance with NFPA 80, Section 5.2.

C. Repair or remove and replace installations where inspections indicate that they do not comply with specified requirements.

D. Reinspect repaired or replaced installations to determine if replaced or repaired door assembly installations comply with specified requirements.

E. Prepare and submit separate inspection report for each fire-rated access door indicating compliance with each item listed in NFPA 80 and NFPA 101.

3.4 ADJUSTING

A. Adjust doors and hardware, after installation, for proper operation.

END OF SECTION

This page is intentionally left blank.

SECTION 08 33 23 - OVERHEAD COILING DOORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Insulated service doors.

B. Related Requirements:

1. Section 08 71 00 “Door Hardware” for cylinder and keys for key-operated control station.
2. Section 11 12 00 “Vehicle Access Control Systems” for operation with access control units.
3. Division 28 “Electronic Safety and Security” for providing signal to door control from Command Center.

1.2 COORDINATION

A. Coordinate overhead coiling door and door operator selection with available head height.

1.3 ACTION SUBMITTALS

A. Product Data: For each type and size of overhead coiling door and accessory.

1. Include construction details, material descriptions, dimensions of individual components, profiles for slats, and finishes.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished accessories.

B. Shop Drawings: For each installation and for special components not dimensioned or detailed in manufacturer's product data.

1. Include plans, elevations, sections, and mounting details.
2. Include details of equipment assemblies, and indicate dimensions, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include points of attachment and their corresponding static and dynamic loads imposed on structure.
4. For exterior components, include details of provisions for assembly expansion and contraction and for excluding and draining moisture to the exterior.
5. Show locations of controls and other accessories.
6. Include diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Sample Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Special warranty.

B. Maintenance Data: For overhead coiling doors to include in maintenance manuals.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer for both installation and maintenance of units required for this Project.

1. Maintenance Proximity: Not more than two hours' normal travel time from Installer's place of business to Project site.

1.7 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of doors that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain overhead coiling doors from single source from single manufacturer.

1. Obtain operators and controls from overhead coiling-door manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Structural Performance, Exterior Doors: Capable of withstanding the following design wind loads:

1. Design Wind Load: As indicated on Drawings but not less than a uniform pressure (velocity pressure) of 20 lbf/sq. ft., acting inward and outward.
2. Testing: According to ASTM E330/E330M or DASMA 108 for garage doors and complying with acceptance criteria of DASMA 108.
3. Deflection Limits: Design overhead coiling doors to withstand design wind load without evidencing permanent deformation or disengagement of door components.

4. Operability under Wind Load: Design overhead coiling doors to remain operable under uniform pressure (velocity pressure) of 20-lbf/sq. ft. wind load, acting inward and outward.

2.3 DOOR ASSEMBLY

A. Insulated Service Door: Overhead coiling door formed with curtain of interlocking metal slats.

1. Basis-of-Design Product: Subject to compliance with requirements, provide **Overhead Door Corporation; Model 625 with RSX Operator** or a comparable product by one of the following:

a. Clopay Building Products.
b. Cookson; a CornellCookson company.
c. Cornell; a CornellCookson company.
d. McKeon Door Company.
e. Raynor Garage Doors.
f. Wayne Dalton; a division of Overhead Door Corporation.

B. Operation Cycles: Door components and operators capable of operating for not less than 20,000. One operation cycle is complete when a door is opened from the closed position to the fully open position and returned to the closed position.

1. Include tamperproof cycle counter.

C. Air Infiltration: Maximum rate of 1.0 cfm/sq. ft. at 15 and 25 mph when tested according to ASTM E283.

D. Insulated Door Curtain R-Value: 4.5 deg F x h x sq. ft./Btu.

E. Door Curtain Material: Galvanized steel.

F. Door Curtain Slats: Flat profile slats of 2-5/8-inch center-to-center height.

1. Insulated-Slat Interior Facing: Metal.

G. Bottom Bar: Two angles, each not less than 1-1/2 by 1-1/2 by 1/8 inch thick; fabricated from hot-dip galvanized steel and finished to match door.

H. Curtain Jamb Guides: Galvanized steel with exposed finish matching curtain slats.

I. Hood: Match curtain material and finish.

1. Shape: As indicated on Drawings.
2. Mounting: As indicated on Drawings.

J. Electric Door Operator:

1. Usage Classification: Constant duty, 25 or more cycles per hour and up to 90 cycles per day.
2. Operator Location: As indicated on Drawings.
3. Motor Exposure: Interior.
4. Emergency Manual Operation: Chain type.

5. Obstruction-Detection Device: Automatic photoelectric sensor; self-monitoring type.
6. Control Station(s): Where indicated on Drawings.

K. Curtain Accessories: Equip door with weatherseals.

L. Door Finish:

1. Baked-Enamel or Powder-Coated Finish: Custom color As preselected and indicated in Finish Schedule.
2. Interior Curtain-Slat Facing: Match finish of exterior curtain-slat face.

2.4 MATERIALS, GENERAL

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.5 DOOR CURTAIN MATERIALS AND CONSTRUCTION

A. Door Curtains: Fabricate overhead coiling-door curtain of interlocking metal slats, designed to withstand wind loading indicated, in a continuous length for width of door without splices. Unless otherwise indicated, provide slats of thickness and mechanical properties recommended by door manufacturer for performance, size, and type of door indicated, and as follows:

1. Steel Door Curtain Slats: Zinc-coated (galvanized), cold-rolled structural-steel sheet; complying with ASTM A653/A653M, with G90 zinc coating; nominal sheet thickness (coated) of 0.028 inch; and as required.
2. Insulation: Fill slats for insulated doors with manufacturer's standard thermal insulation complying with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, according to ASTM E84 or UL 723. Enclose insulation completely within slat faces.
3. Metal Interior Curtain-Slat Facing: Match metal of exterior curtain-slat face, with minimum steel thickness of 0.010 inch.

B. Curtain Jamb Guides: Manufacturer's standard angles or channels and angles of same material and finish as curtain slats unless otherwise indicated, with sufficient depth and strength to retain curtain, to allow curtain to operate smoothly, and to withstand loading. Slot bolt holes for guide adjustment. Provide removable stops on guides to prevent overtravel of curtain.

2.6 HOODS

A. General: Form sheet metal hood to entirely enclose coiled curtain and operating mechanism at opening head. Contour to fit end brackets to which hood is attached. Roll and reinforce top and bottom edges for stiffness. Form closed ends for surface-mounted hoods and fascia for any portion of between-jamb mounting that projects beyond wall face. Equip hood with intermediate support brackets as required to prevent sagging.

1. Galvanized Steel: Nominal 0.028-inch-thick, hot-dip galvanized-steel sheet with G90 zinc coating, complying with ASTM A653/A653M.

2.7 CURTAIN ACCESSORIES

A. Weatherseals for Exterior Doors: Equip each exterior door with weather-stripping gaskets fitted to entire exterior perimeter of door for a weather-resistant installation unless otherwise indicated.

1. At door head, use 1/8-inch-thick, replaceable, continuous-sheet baffle secured to inside of hood or field-installed on the header.
2. At door jambs, use replaceable, adjustable, continuous, nylon brushes.

B. Pull-Down Strap: Provide pull-down straps for doors more than 84 inches high.

C. Pole Hooks: Provide pole hooks and poles for doors more than 84 inches high.

2.8 COUNTERBALANCE MECHANISM

A. General: Counterbalance doors by means of manufacturer's standard mechanism with an adjustable-tension, steel helical torsion spring mounted around a steel shaft and contained in a spring barrel connected to top of curtain with barrel rings. Use grease-sealed bearings or self-lubricating graphite bearings for rotating members.

B. Counterbalance Barrel: Fabricate spring barrel of manufacturer's standard hot-formed, structural-quality, seamless carbon-steel pipe, of sufficient diameter and wall thickness to support rolled-up curtain without distortion of slats and to limit barrel deflection to not more than 0.03 in./ft. of span under full load.

C. Counterbalance Spring: One or more oil-tempered, heat-treated steel helical torsion springs. Size springs to counterbalance weight of curtain, with uniform adjustment accessible from outside barrel. Secure ends of springs to barrel and shaft with cast-steel barrel plugs.

1. Fire-Rated Doors: Equip with auxiliary counterbalance spring and prevent tension release from main counterbalance spring when automatic-closing device operates.

D. Torsion Rod for Counterbalance Shaft: Fabricate of manufacturer's standard cold-rolled steel, sized to hold fixed spring ends and carry torsional load.

E. Brackets: Manufacturer's standard mounting brackets of either cast iron or cold-rolled steel plate.

2.9 ELECTRIC DOOR OPERATORS

A. General: Electric door operator assembly of size and capacity recommended and provided by door manufacturer for door and operation-cycles requirement specified, with electric motor and factory-prewired motor controls, starter, gear-reduction unit, solenoid-operated brake, clutch, control stations, control devices, integral gearing for locking door, and accessories required for proper operation.

1. Comply with NFPA 70.
2. Control equipment complying with NEMA ICS 1, NEMA ICS 2, and NEMA ICS 6, with NFPA 70 Class 2 control circuit, maximum 24-V ac or dc.

B. Usage Classification: Electric operator and components capable of operating for not less than number of cycles per hour indicated for each door.

C. Door Operator Location(s): As indicated and approved on Shop Drawings.

D. Motors: Reversible-type motor with controller (disconnect switch) for motor exposure indicated for each door assembly.

1. Electrical Characteristics: Minimum as indicated for each door assembly. If not indicated, large enough to start, accelerate, and operate door in either direction from any position, at a speed not less than 8 in./sec. and not more than 12 in./sec., without exceeding nameplate ratings or service factor.
2. Operating Controls, Controllers, Disconnect Switches, Wiring Devices, and Wiring: Manufacturer's standard unless otherwise indicated.
3. Coordinate wiring requirements and electrical characteristics of motors and other electrical devices with building electrical system and each location where installed.

E. Limit Switches: Equip each motorized door with adjustable switches interlocked with motor controls and set to automatically stop door at fully opened and fully closed positions.

F. Obstruction-Detection Devices: External entrapment protection consisting of indicated automatic safety sensor capable of protecting full width of door opening. For non-fire-rated doors, activation of device immediately stops and reverses downward door travel.

1. Electric Sensor Edge: Automatic safety sensor edge, located within astragal or weather stripping mounted to bottom bar. Contact with sensor activates device. Connect to control circuit using manufacturer's standard take-up reel or self-coiling cable.

a. Self-Monitoring Type: Four-wire-configured device designed to interface with door operator control circuit to detect damage to or disconnection of sensor edge.

G. Control Station: Three-button control station in fixed location with momentary-contact push-button controls labeled "Open" and "Stop" and sustained- or constant-pressure push-button control labeled "Close."

1. Interior-Mounted Units: Full-guarded, surface-mounted, heavy-duty type, with general-purpose NEMA ICS 6, Type 1 enclosure.

H. Emergency Manual Operation: Equip each electrically powered door with capability for emergency manual operation. Design manual mechanism so required force for door operation does not exceed 25 lbf.

I. Emergency Operation Disconnect Device: Equip operator with hand-operated disconnect mechanism for automatically engaging manual operator and releasing brake for emergency manual operation while disconnecting motor without affecting timing of limit switch. Mount mechanism so it is accessible from floor level. Include interlock device to automatically prevent motor from operating when emergency operator is engaged.

J. Motor Removal: Design operator so motor may be removed without disturbing limit-switch adjustment and without affecting emergency manual operation.

K. Access-Control System: Control device to open door from card reader.

2.10 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM/NOMMA 500 for recommendations for applying and designating finishes.

B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.11 STEEL AND GALVANIZED-STEEL FINISHES

A. Baked-Enamel or Powder-Coat Finish: Manufacturer's standard baked-on finish consisting of prime coat and thermosetting topcoat. Comply with coating manufacturer's written instructions for cleaning, pretreatment, application, and minimum dry film thickness.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates areas and conditions, with Installer present, for compliance with requirements for substrate construction and other conditions affecting performance of the Work.

B. Examine locations of electrical connections.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Install overhead coiling doors and operating equipment complete with necessary hardware, anchors, inserts, hangers, and equipment supports; according to manufacturer's written instructions and as specified.

B. Install overhead coiling doors, hoods, controls, and operators at the mounting locations indicated for each door.

C. Accessibility: Install overhead coiling doors, switches, and controls along accessible routes in compliance with the accessibility standard.

D. Power-Operated Doors: Install according to UL 325.

E. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.
2. After electrical circuitry has been energized, operate doors to confirm proper motor rotation and door performance.
3. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.

3.3 ADJUSTING

A. Adjust hardware and moving parts to function smoothly so that doors operate easily, free of warp, twist, or distortion.

1. Adjust exterior doors and components to be weather resistant.

B. Lubricate bearings and sliding parts as recommended by manufacturer.

C. Adjust seals to provide tight fit around entire perimeter.

3.4 DEMONSTRATION

A. Engage a factory-authorized service representative to train Operator's maintenance personnel to adjust, operate, and maintain overhead coiling doors.

END OF SECTION

SECTION 08 33 43 - OVERHEAD COILING SMOKE CURTAINS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Smoke-protective curtain assemblies for elevator entrances.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 COORDINATION

A. Coordinate smoke curtain assemblies with power, signal, fire-alarm, and smoke-detection systems specified in Division 26 and Division 28.

B. Coordinate elevator smoke-protective curtain assemblies with elevator hoistway door frames specified in Division 14.

C. Coordinate smoke-protective curtain assemblies with ceilings for operational clearances and maintenance access requirements.

D. Coordinate smoke-protective curtain assemblies with walls for support requirements, rating continuity above ceilings, and recessed wall switches.

E. Coordinate requirements for metal supports required for smoke-protective curtain assemblies.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of smoke-protective curtain assembly and draft curtain.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for smoke curtains.
2. Include points of attachment and their corresponding static and dynamic loads imposed on structure.
3. Include ratings, operating components, electrical characteristics, control systems, and furnished specialties and accessories.

B. Shop Drawings: For each installation and for special components not dimensioned or detailed in manufacturer's product data.

1. Include plans, elevations, sections, and attachment details.

2. Include details of smoke curtain assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location of each field connection.
3. Include points of attachment and their corresponding static and dynamic loads imposed on structure.
4. Detail fabrication and assembly of fire-protective curtain assemblies.
5. Show locations of controls, detectors, and other accessories.
6. Include diagrams for power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer, manufacturer, testing agency, and factory-authorized service representative.

B. Evaluation Reports: For curtain assemblies, from ICC-ES or another qualified testing agency.

C. Sample Warranty: For manufacturer's special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For smoke curtain assemblies to include in emergency, operation, and maintenance manuals.

1.7 QUALITY ASSURANCE

A. Manufacturer Qualifications: An entity experienced in manufacturing smoke-and-draft-control curtain assemblies that have been successfully installed in compliance with requirements of authorities having jurisdiction.

B. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer for both installation and maintenance of units required for this Project.

1.8 FIELD CONDITIONS

A. Field Measurements: Field-verify and coordinate dimensions and indicate measurements on Shop Drawings.

1.9 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of curtain assemblies that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS, GENERAL

A. Source Limitations: Obtain smoke-protective curtains from single source from single manufacturer.

1. Obtain operators and controls from smoke-protective curtain manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Smoke Protective Curtain Assemblies: Provide smoke-protective curtains that are listed and labeled with the letter "S" on the rating label by a qualified testing agency for smoke- and draft-control based on testing in accordance with UL 1784; with maximum air-leakage rate of 3.0 cfm/sq. ft. of opening at 0.10 inch wg for both ambient and elevated temperature tests.

B. Curtain Fabric Fire-Test-Response Characteristics: Provide products that pass NFPA 701, as determined by testing of fabrics that were treated using treatment-application method intended for use for this Project by a testing and inspecting agency acceptable to authorities having jurisdiction.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.3 SMOKE-PROTECTIVE CURTAIN ASSEMBLIES FOR ELEVATOR ENTRANCES

A. Alarm-activated transparent-film smoke curtain assembly complying with ICC-ES AC77.

B. Basis-of-Design Product: Subject to compliance with requirements, provide **Smoke Guard, a CSW Industrials Company; Elevator Smoke Curtain: M400** or a comparable product by one of the following:

1. Cornell; a CornellCookson company.
2. Door Systems.

C. Smoke Containment: Assemblies complying with UL 1784 for air leakage and requirements of ASME 17.1/CSA B44.

D. Transparent-Film Curtain: Manufacturer's standard transparent film with flame-spread and smoke-developed indexes of 25 and 450, respectively, when tested in accordance with ASTM E84.

E. Operation: Controlled descent automatically by fail-safe gravity deployment and motorized rewind.

F. Curtain Attachment: Curtain shall form a pressure-resisting seal by one of the following methods:

1. Magnetic Adhesion: With Type 430 ferritic stainless steel elevator door frames, use magnets for closure with door frame.

G. Control System: Provide factory-assembled control unit as required for assembly specified.

1. Fail-safe, gravity-closing device deploys on activation of local smoke detector and building fire alarm or testing key switch in compliance with UL 864.
2. Curtain Rewind Switch: Include switch to rewind screen into housing.
3. Motor Operator: Provide factory-assembled electric operation system of size and capacity recommended in writing by curtain manufacturer for assembly specified, with electric motors and factory-prewired motor controls, control devices, and accessories required for proper operation.
4. Electrical Components, Devices, and Accessories: Listed and labeled in accordance with NFPA 70, by a qualified testing agency, and marked for intended location and application.

H. Housing Type: Sheet metal housings containing support rollers and associated electronics.

1. Coordinate operator wiring requirements and electrical characteristics with building electrical system.
2. Provide housing with electrical junction box that does not require the removal of any part of the building in accordance with NFPA 70.
3. Provide electrical junction box access through housing in the open condition.
4. Provide curtain housing containing all components required for operation.
5. Housing Finish: Powder coat in custom color to match color provided by Architect.

I. Manual Egress: Provide curtain allowing fail-safe manual egress with less than 15 pounds release pressure in the direction of travel.

1. Opening Size: Provide curtain with manual egress opening of at least 32 inches in compliance with the requirements of authorities having jurisdiction.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrate areas and conditions, with Installer present, for compliance with requirements for substrate construction and other conditions affecting performance of the Work.

B. Examine locations of electrical connections.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Smoke-Protective Curtains: Install smoke-protective curtain assemblies in accordance with manufacturer's written installation instructions and NFPA 105.

1. Install smoke-protective curtain assemblies for elevator entrances in accordance with ASME 17.1/CSA B44.

B. Power-Operated Curtains: Install in accordance with UL 864.

C. Install anchorage devices to securely fasten assembly to substrate and building framing without distortion or stress.

D. Securely brace components suspended from structure.

E. Fit and align assembly, including vertical guides, level and plumb, to provide smooth operation.

3.3 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified opening protective assembly inspector to perform tests and inspections and to furnish reports to Architect.

B. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. Test release mechanism, closing, and alarm operations when activated by smoke detector or building's fire-alarm system. Test manual operation of closed curtain. Reset closing mechanism after successful test.
2. Inspections: Inspect each smoke-protective curtain assembly in accordance with NFPA 105.

C. Repair or remove and replace installations where inspections indicate that they do not comply with specified requirements.

D. Reinspect repaired or replaced installations to determine if replaced or repaired door assembly installations comply with specified requirements.

E. Prepare and submit separate inspection report for each smoke-protective curtain assembly indicating compliance with each item listed in NFPA 105.

3.4 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain overhead coiling smoke curtains.

3.5 MAINTENANCE

A. Engage a manufacturer's authorized service representative to test, adjust, and maintain the smoke-protective assemblies once per year, as required by NFPA 105.

END OF SECTION

This page is intentionally left blank.

SECTION 08 41 26.23 - INTERIOR ALL-GLASS ENTRANCES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Interior, manual-swinging, all-glass entrance systems.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data:

1. Interior, manual-swinging, all-glass entrance systems.

B. Product Data Submittals: For each product.

1. Construction details, material descriptions, dimensions of individual components and profiles, and finishes.

C. Shop Drawings:

1. Plans, elevations, and sections.
2. Details of fittings and glazing, including isometric drawings of fittings.
3. Door hardware locations, mounting heights, and installation requirements.

D. Samples for Initial Selection: Manufacturer's standard color sheets, showing full range of available colors for each type of fitting, accessory fitting, glass, and door hardware.

1. Samples for Verification: Actual sample of finished products for each type of fitting, accessory fitting, glass, and door hardware. Size: Manufacturers' standard size.

E. Fabrication Sample: Continuous rail fitting at bottom, made from 12-inch lengths of full-size components and showing details of the following:

1. Joinery.
2. Anchorage.
3. Glazing.

F. Entrance Door Hardware Schedule: Prepared by or under supervision of supplier, detailing fabrication and assembly of door hardware, as well as procedures and diagrams. Coordinate

final door hardware schedule with door components, assemblies, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Statements:

1. For Installer.

B. Sample Warranties: For interior all-glass entrance systems.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For interior all-glass entrance systems. Furnish a complete set of specialized tools and maintenance instructions as required for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.

1.6 QUALITY ASSURANCE

A. Installer Qualifications:

1. Authorized representative who is trained and approved by manufacturer.

B. Product Options: Information on Drawings and in Specifications establishes requirements for aesthetic effects and performance characteristics of assemblies. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction.

1. Do not change intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If changes are proposed, submit comprehensive explanatory data to Architect for review.

1.7 WARRANTY

A. Special Warranty: Manufacturer and Installer agree to repair or replace components of interior all-glass entrance systems that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Faulty operation.
b. Deterioration of metals, metal finishes, and other materials beyond normal use.

2. Warranty Period: Two years from date of Substantial Completion.

a. Concealed Floor Closers: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Obtain all components of interior all-glass entrance systems, including accessories, from single manufacturer.

2.2 INTERIOR, MANUAL-SWINGING, ALL-GLASS ENTRANCE SYSTEMS

A. Basis-of-Design Product: Subject to compliance with requirements, provide **C.R. Laurence Co., Inc.; Blumcraft 1301** or a comparable product by one of the following:

1. PRL Glass Systems Inc.
2. Virginia Glass Products Corporation.

B. Fitting Configuration:

1. Door Fittings: Continuous rail fitting at top and bottom.
2. Sidelight Fittings: Continuous rail fitting at top and bottom.

C. Fitting Material: Bronze-clad aluminum.

D. Rail Fittings:

1. Height:

a. Top Rail: 3/4 inch.
b. Bottom Rail: 3/4 inch.

2. Profile: Square.
3. End Caps: Manufacturer's standard precision-fit end caps for rail fittings.

E. Accessory Fittings:

1. Overhead doorstop.
2. Center-housing lock.
3. U-channel.

F. Anchors and Fastenings: Concealed.

G. Door Hardware: In sizes, quantities, and types recommended by manufacturer for interior all-glass entrance systems indicated. For exposed parts, match metal and finish of fittings.

1. Concealed Floor Closers and Top Pivots: Center hung; ANSI/BHMA A156.4, Grade 1; including cases, bottom arms, top walking beam pivots, plates, and accessories required for complete installation.
2. Swing: Single acting.

a. Positive Dead Stop: Coordinated with hold-open angle if any, or at angle selected.

3. Hold Open: Automatic, at angle selected.
4. Opening-Force Requirements:

5. Concealed Overhead Holder: ANSI/BHMA A156.8, Grade 1, with dead-stop setting coordinated with concealed floor closer.
6. Push-Pull Set: As selected from manufacturer's full range.
7. Single-Door and Active-Leaf Locksets: Locking ladder pulls with concealed deadbolt.
8. Deadbolt operated by key outside and key inside.
9. Cylinders: As specified in Section 08 71 00 "Door Hardware."
10. Threshold: Not more than 1/2 inch high.

2.3 GLASS

A. Glass: ASTM C1048, Kind FT (fully tempered), Condition A (uncoated surfaces), Type I (transparent), Quality-Q3, tested for surface and edge compression in accordance with ASTM C1048 and for impact strength in accordance with 16 CFR 1201 for Category II materials.

1. Class 1: Clear monolithic.

a. Thickness: 12 mm.

2. Exposed Edges: Machine ground and flat polished.
3. Butt Edges: Flat ground.

2.4 MATERIALS

A. Aluminum: ASTM B221 with strength and durability characteristics of not less than Alloy 6063-T5 for extruded bars, rods, profiles, and tubes. ASTM B209 for sheet and plate.

1. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.

B. Bronze Cladding: ASTM B36/B36M, Alloy UNS C28000 (muntz metal, 60 percent copper).

1. Finish: Satin M31-M34-O6x.

2.5 FABRICATION

A. Provide holes and cutouts in glass to receive hardware, fittings, and accessory fittings before tempering glass. Do not cut, drill, or make other alterations to glass after tempering.

1. Fully temper glass using horizontal (roller-hearth) process, and fabricate so that when glass is installed, roll-wave distortion is parallel with bottom edge of door or lite.

B. Factory assemble components and factory install hardware and fittings to greatest extent possible.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Install interior all-glass entrance systems and associated components in accordance with manufacturer's written instructions.

B. Set units level, plumb, and true to line, with uniform joints.

C. Maintain uniform clearances between adjacent components.

D. Lubricate hardware and other moving parts in accordance with manufacturer's written instructions.

E. Set, seal, and grout floor closer cases as required to suit hardware and substrate indicated.

3.3 ADJUSTING AND CLEANING

A. Adjust all-glass doors and hardware to function smoothly and fit tightly at contact points.

B. Remove excess sealant and glazing compounds and dirt from surfaces.

END OF SECTION

This page is intentionally left blank.

SECTION 08 44 13 - GLAZED ALUMINUM CURTAIN WALLS

PART 1 - GENERAL

1.1 SUMMARY

A. Description of Work: Glazed aluminum curtain walls including CW-1, conventionally glazed; CW-2, structural-sealant-glazed and additionally retained mechanically, forced entry rated with protection level of 5 minutes; and, CW-4, conventionally glazed with operable lites interconnected with fire alarm system.

B. Section Includes:

1. Glazed aluminum curtain wall systems:

a. Conventionally and structural-sealant-glazed with operable lites.

2. Formed metal spandrel panels.
3. Aluminum-framed entrance door systems.

C. Related Requirements:

1. Section 07 21 00 “Thermal Insulation” for insulation material used in spandrels.
2. Section 08 56 53 “Security Windows” for ballistic resistant curtain walls.
3. Section 08 75 16 “Window Operators” for motorized window actuators and controls as part of atrium smoke evacuation system.
4. Section 08 71 13 “Power Door Operators” for power door operators on swinging doors where indicated.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Sustainable Design Submittals:

1. Product Data: For sealants, indicating VOC content.
2. Laboratory Test Reports: For sealants, indicating compliance with requirements for low-emitting materials.
3. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.

4. Environmental Product Declaration: For each product.
5. Health Product Declaration: For each product.
6. Sourcing of Raw Materials: Corporate sustainability report for each manufacturer.

C. Shop Drawings: For glazed aluminum curtain walls. Include plans, elevations, sections, full-size details, and attachments to other work.

1. Include details of provisions for assembly expansion and contraction and for draining moisture occurring within the assembly to the exterior.
2. Include full-size isometric details of each type of vertical-to-horizontal intersection of glazed aluminum curtain walls, showing the following:

    a. Joinery, including concealed welds.
    b. Anchorage.
    c. Expansion provisions.
    d. Glazing.
    e. Flashing and drainage.

3. Show connection to and continuity with adjacent thermal, weather, air, and vapor barriers.

D. Fabrication Sample: Of each vertical-to-horizontal intersection of assemblies, made from 12-inch lengths of full-size components and showing details of the following:

1. Joinery, including concealed welds.
2. Anchorage.
3. Expansion provisions.
4. Glazing.
5. Flashing and drainage.

E. Entrance Door Hardware Schedule: Prepared by or under supervision of supplier, detailing fabrication and assembly of entrance door hardware, as well as procedures and diagrams. Coordinate final entrance door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of entrance door hardware.

F. Delegated-Design Submittal: For glazed aluminum curtain walls, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data:

1. For Installer.
2. For professional engineer's experience with providing delegated-design engineering services of the kind indicated, including documentation that engineer is licensed in the state in which Project is located.

B. Energy Performance Certificates: For glazed aluminum curtain walls, accessories, and components from manufacturer.

1. Basis for Certification: NFRC-certified energy performance values for each glazed aluminum curtain wall.

C. Product Test Reports: For glazed aluminum curtain walls, for tests performed by a qualified testing agency.

D. Quality-Control Program: Developed specifically for Project, including fabrication and installation, in accordance with recommendations in ASTM C1401. Include periodic quality-control reports.

E. Source quality-control reports.

F. Sample Warranties: For special warranties.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For glazed aluminum curtain walls to include in maintenance manuals.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer and that employs a qualified glazing contractor for this Project who is certified under the North American Contractor Certification Program (NACC) for Architectural Glass & Metal (AGM) contractors and that employs glazing technicians certified under the Architectural Glass and Metal Technician (AGMT) certification program.

B. Product Options: Information on Drawings and in Specifications establishes requirements for aesthetic effects and performance characteristics of assemblies. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction.

1. Do not change intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If changes are proposed, submit comprehensive explanatory data to Architect for review.

C. Structural-Sealant Glazing: Comply with ASTM C1401 for design and installation of structural-sealant-glazed curtain wall assemblies.

1.7 MOCKUPS

A. Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.

1. Build mockup of typical wall area as shown on Drawings as part of integrated exterior mockup specified in Section 01 43 39 “Mockups.”
2. Testing shall be performed on mockups in accordance with requirements in "Field Quality Control" Article.
3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

1.8 WARRANTY

A. Special Assembly Warranty: Installer agrees to repair or replace components of glazed aluminum curtain wall that do not comply with requirements or that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures including, but not limited to, excessive deflection.
b. Noise or vibration created by wind and thermal and structural movements.
c. Deterioration of metals and other materials beyond normal weathering.
d. Water penetration through fixed glazing and framing areas.
e. Failure of operating components.

2. Warranty Period: 10 years from date of Substantial Completion.

B. Special Finish Warranty, Factory-Applied Finishes: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of baked enamel, powder coat, or organic finishes within specified warranty period.

1. Deterioration includes, but is not limited to, the following:

a. Color fading more than 5 Delta E units when tested in accordance with ASTM D2244.
b. Chalking in excess of a No. 8 rating when tested in accordance with ASTM D4214.
c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design glazed aluminum curtain walls.

B. General Performance: Comply with performance requirements specified, as determined by testing of glazed aluminum curtain walls representing those indicated for this Project without failure due to defective manufacture, fabrication, installation, or other defects in construction.

1. Glazed aluminum curtain walls shall withstand movements of supporting structure, including, but not limited to, story drift, twist, column shortening, long-term creep, and deflection from uniformly distributed and concentrated live loads.
2. Failure also includes the following:

a. Thermal stresses transferring to building structure.
b. Glass breakage.
c. Noise or vibration created by wind and thermal and structural movements.
d. Loosening or weakening of fasteners, attachments, and other components.
e. Failure of operating units.

C. Forced Entry: Comply with U.S. Department of State, Diplomatic Security Standard STD-01.01, revision G.

1. Protection Level: 5 min.

D. Structural Loads:

1. Wind Loads: As indicated on Drawings.

E. Deflection of Framing Members Supporting Glass: At design wind load, as follows:

1. Deflection Normal to Wall Plane: Limited to 1/175 of clear span for spans of up to 13 feet 6 inches and to 1/240 of clear span plus 1/4 inch for spans of greater than 13 feet 6 inches.
2. Deflection Parallel to Glazing Plane: Limited to amount not exceeding that which reduces glazing bite to less than 75 percent of design dimension and that which reduces edge clearance between framing members and glazing or other fixed components to less than 1/8 inch.

a. Operable Units: Provide a minimum 1/16-inch clearance between framing members and operable units.

3. Cantilever Deflection: Limited to 2l/175 at unsupported cantilevers.

F. Deflection of Metal Spandrel Panels: For design wind loads, no greater than 1/180 of the span.

G. Structural: Test in accordance with ASTM E330/E330M as follows:

1. When tested at positive and negative wind-load design pressures, assemblies do not evidence deflection exceeding specified limits.
2. When tested at 150 percent of positive and negative wind-load design pressures, assemblies, including anchorage, do not evidence material failures, structural distress, or permanent deformation of main framing members exceeding 0.2 percent of span.
3. Test Durations: As required by design wind velocity, but not less than 10 seconds.

H. Water Penetration under Static Pressure: Test in accordance with ASTM E331 as follows:

1. No evidence of water penetration through fixed glazing and framing areas when tested in accordance with a minimum static-air-pressure differential of 20 percent of positive wind-load design pressure, but not less than 15 lbf/sq. ft..

I. Water Penetration under Dynamic Pressure: Test in accordance with AAMA 501.1 as follows:

1. No evidence of water penetration through fixed glazing and framing areas when tested at dynamic pressure equal to 20 percent of positive wind-load design pressure, but not less than 15 lbf/sq. ft..
2. Maximum Water Leakage: No uncontrolled water penetrating assemblies or water appearing on assemblies' normally exposed interior surfaces from sources other than condensation. Water leakage does not include water controlled by flashing and gutters or water that is drained to exterior.

J. Interstory Drift: Accommodate design displacement of adjacent stories indicated.

1. Design Displacement: As indicated on Drawings.
2. Test Performance: Complying with criteria for passing based on building occupancy type when tested in accordance with AAMA 501.4 at design displacement.

K. Energy Performance: Certified by manufacturer for energy performance as follows:

1. Thermal Transmittance (U-factor):

a. Fixed Glazing and Framing Areas: U-factor for the system of not more than 0.38 Btu/sq. ft. x h x deg F as determined in accordance with NFRC 100.

2. Solar Heat Gain Coefficient (SHGC):

a. Fixed Glazing and Framing Areas: SHGC for the system of not more than 0.36 as determined in accordance with NFRC 200.

3. Air Leakage:

a. Fixed Glazing and Framing Areas: Air leakage for the system of not more than 0.06 cfm/sq. ft. at a static-air-pressure differential of 6.24 lbf/sq. ft. when tested in accordance with ASTM E283.

4. Condensation Resistance Factor (CRF):

a. Fixed Glazing and Framing Areas: CRF for the system of not less than 65 as determined in accordance with AAMA 1503.

L. Thermal Movements: Allow for thermal movements resulting from ambient and surface temperature changes:

1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

M. Structural-Sealant Joints:

N. Structural Sealant: ASTM C1184. Capable of withstanding tensile and shear stresses imposed by structural-sealant-glazed curtain walls without failing adhesively or cohesively. When tested for preconstruction adhesion and compatibility, cohesive failure of sealant shall occur before adhesive failure.

1. Adhesive failure occurs when sealant pulls away from substrate cleanly, leaving no sealant material behind.
2. Cohesive failure occurs when sealant breaks or tears within itself but does not separate from each substrate, because sealant-to-substrate bond strength exceeds sealant's internal strength.

2.2 SOURCE LIMITATIONS

A. Obtain all components of curtain-wall system, including framing spandrel panels, entrances, and accessories, from single manufacturer.

2.3 GLAZED ALUMINUM CURTAIN WALL SYSTEMS

A. Basis-of-Design Product: Subject to compliance with requirements, provide **Kawneer Company, Inc.; Arconic Corporation; 1600UT System 1** or a comparable product by one of the following:

1. EFCO Corporation.
2. OldCastle BuildingEnvelope (OBE).
3. Wausau Window and Wall Systems; Apogee Wausau Group, Inc.
4. YKK AP America Inc.

B. Framing Members: Manufacturer's extruded- or formed-aluminum framing members of thickness required and reinforced as required to support imposed loads.

1. Construction: Thermally broken.
2. Glazing System, CW-1: Retained mechanically with gaskets on four sides.
3. Glazing System, CW-2: Structural sealant glazed on four sides and additionally retained mechanically with gaskets on four sides.
4. Glazing Plane: Front.
5. Finish: High-performance organic finish.
6. System: Stick system.
7. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
8. Steel Reinforcement: As required by manufacturer.

C. Pressure Caps: Manufacturer's standard aluminum components that mechanically retain glazing.

1. Include snap-on aluminum trim that conceals fasteners.

D. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.

E. Formed Metal Spandrel Panels: Formed aluminum panels, in configurations indicated, to be glazed into curtain wall glazing pocket with crisp corners; all seams fully welded and sealed watertight.

1. Aluminum Sheet: Tension-leveled, smooth aluminum sheet, ASTM B209.
2. Thickness: As required to comply with Performance Requirements but not less than 0.102 inch.
3. Finish: High-performance organic finish to match adjacent curtain wall framing.

F. Venting Windows, CW-4:

1. Basis-of-Design Product: Subject to compliance with requirement, provide **Kawneer Company, Inc.; Arconic Corporation; Glassvent UT Window** or comparable product by one of the following:

    a. EFCO Corporation.
    b. OldCastle BuildingEnvelope (OBE).
    c. Wausau Window and Wall Systems; Apogee Wausau Group, Inc.
    d. YKK AP America Inc.

2. Manufacturer's standard units, complying with AAMA/WDMA/CSA 101/I.S.2/A440, with self-flashing mounting fins, and as follows:

    a. Window Type: Project-out.
    b. Minimum Performance Class: AW-PG80-AP.

c. Hardware: Manufacturer's standard; of aluminum, stainless steel, die-cast steel, malleable iron, or bronze; including the following:

1) Rotary operator motorized and operated by signal from fire alarm system as specified in Section 08 75 16 “Window Operators.”

d. Weather Stripping: Provide full-perimeter weather stripping for each operable sash unless otherwise indicated.

e. Glazing: Same as adjacent glazed aluminum curtain-wall glazing.
f. Finish: Match adjacent glazed aluminum curtain-wall finish.

G. Entrance Door Systems:

1. Basis-of-Design Product: Subject to compliance with requirement, provide **Kawneer Company, Inc., Arconic Corporation; Insulpour Thermal Entrances** or comparable product by one of the following:

a. Arcadia, Inc.
b. EFCO Corporation.
c. Oldcastle BuildingEnvelope (OBE); CRH Americas, Inc.
d. YKK AP America Inc.

2. Entrance Doors: Manufacturer's standard glazed entrance doors for manual-swing or automatic operation.

a. Door Construction: 2-1/4-inch overall thickness, with minimum 0.125-inch- thick, extruded-aluminum tubular rail and stile members. Mechanically fasten corners with reinforcing brackets that are deeply penetrated and fillet welded or that incorporate concealed tie rods.

1) Thermal Construction: High-performance plastic connectors separate aluminum members exposed to the exterior from members exposed to the interior.

b. Door Design: Wide stile; 5-inch nominal width.
c. Glazing Stops and Gaskets: Square, snap-on, extruded-aluminum stops and preformed gaskets.

1) Provide nonremovable glazing stops on outside of door.

d. Finish: Match adjacent glazed aluminum curtain-wall finish.

3. Entrance Door Hardware: As specified in Section 08 71 00 “Door Hardware.”

2.4 GLAZING

A. Glazing: Comply with Section 08 80 00 "Glazing."

B. Glazing Gaskets: ASTM C509 or ASTM C864. Manufacturer's standard.

1. Color: Black.

C. Glazing Sealants: As recommended by manufacturer.

1. Verify sealant has a VOC content of 250 g/L or less.
2. Verify sealant complies with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

D. Structural Glazing Sealants: ASTM C1184, chemically curing silicone formulation that is compatible with system components with which it comes into contact, specifically formulated and tested for use as structural sealant and approved by structural-sealant manufacturer for use in curtain-wall assembly indicated.

1. Color: Black.

E. Weatherseal Sealants: ASTM C920 for Type S; Grade NS; Class 50; Uses NT, G, A, and O; chemically curing silicone formulation that is compatible with structural sealant and other system components with which it comes into contact; recommended by structural-sealant, weatherseal-sealant, and structural-sealant-glazed curtain-wall manufacturers for this use.

1. Color: Match structural sealant.

2.5 MATERIALS

A. Sheet and Plate: ASTM B209.

B. Extruded Bars, Rods, Profiles, and Tubes: ASTM B221.

C. Structural Profiles: ASTM B308/B308M.

D. Steel Reinforcement:

1. Structural Shapes, Plates, and Bars: ASTM A36/A36M.
2. Cold-Rolled Sheet and Strip: ASTM A1008/A1008M.
3. Hot-Rolled Sheet and Strip: ASTM A1011/A1011M.

E. Steel Reinforcement Primer: Manufacturer's standard zinc-rich, corrosion-resistant primer complying with SSPC-PS Guide No. 12.00; applied immediately after surface preparation and pretreatment. Select surface preparation methods in accordance with recommendations in SSPC-SP COM, and prepare surfaces in accordance with applicable SSPC standard.

F. Recycled Content of Steel Products: Provide products with postconsumer recycled content plus one-half of preconsumer recycled content to the extent required to comply with the minimum criteria specified in Section 01 81 13.14 “Sustainable Design Requirements.”

G. Recycled Content of Aluminum Components: Provide products with postconsumer recycled content plus one-half of preconsumer recycled content to the extent required to comply with the minimum criteria specified in Section 01 81 13.14 “Sustainable Design Requirements.”

H. Regional Materials: To the extent required to comply with the minimum criteria specified in Section 01 81 13.14 “Sustainable Design Requirements,” manufacture products within 100

miles of Project site from materials that have been extracted, harvested, or recovered, as well as manufactured, within 100 miles of Project site.

2.6 ACCESSORIES

A. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.

1. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
2. Reinforce members as required to receive fastener threads.
3. Where unavoidable, use exposed fasteners with countersunk Phillips screw heads, finished to match framing system.

B. Anchors: Three-way adjustable anchors with minimum adjustment of 1 inch that accommodate fabrication and installation tolerances in material and finish compatible with adjoining materials and recommended by manufacturer.

C. Spandrel Insulation: Mineral-wool curtain wall board insulation as specified in Section 07 2100 “Thermal Insulation.”

1. Thickness: As required to meet Performance Requirements but not less than 2 inches.

D. Backpans: 0.063-inch-thick, alloy 5032-H32 aluminum sheet with medium gray finish.

E. Concealed Flashing: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding flashing compatible with adjacent materials.

F. Bituminous Paint: Cold-applied asphalt-mastic paint containing no asbestos, formulated for 30-mil thickness per coat.

2.7 FABRICATION

A. Form or extrude aluminum shapes before finishing.

B. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.

C. Fabricate components that, when assembled, have the following characteristics:

1. Profiles that are sharp, straight, and free of defects or deformations.
2. Accurately fitted joints with ends coped or mitered.
3. Physical and thermal isolation of glazing from framing members.
4. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
5. Provisions for field replacement of glazing from exterior.
6. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.

D. Fabricate components to resist water penetration as follows:

1. Internal guttering system or other means to drain water passing joints, condensation occurring within framing members, and moisture migrating within glazed aluminum curtain wall to exterior.

E. Curtain-Wall Framing: Fabricate components for assembly using manufacturer's standard assembly method.

F. Entrance Door Frames: Reinforce as required to support loads imposed by door operation and for installing entrance door hardware.

1. At interior and exterior doors, provide compression weather stripping at fixed stops.

G. Entrance Doors: Reinforce doors as required for installing entrance door hardware.

1. At pairs of exterior doors, provide sliding-type weather stripping retained in adjustable strip and mortised into door edge.
2. At exterior doors, provide weather sweeps applied to door bottoms.

H. Entrance Door Hardware Installation: Factory install entrance door hardware to the greatest extent possible. Cut, drill, and tap for factory-installed entrance door hardware before applying finishes.

I. After fabrication, clearly mark components to identify their locations in Project in accordance with Shop Drawings.

2.8 ALUMINUM FINISHES

A. High-Performance Organic Finish, Two-Coat PVDF: Fluoropolymer finish complying with AAMA 2605 and containing not less than 70 percent PVDF resin by weight in color coat.

1. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
2. Color and Gloss: As preselected and indicated in Finish Schedule.

2.9 SOURCE QUALITY CONTROL

A. Structural Sealant: Perform quality-control procedures complying with ASTM C1401 recommendations, including, but not limited to, assembly material qualification procedures, sealant testing, and assembly fabrication reviews and checks.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Comply with manufacturer's written instructions.

B. Do not install damaged components.

C. Fit joints to produce hairline joints free of burrs and distortion.

D. Rigidly secure nonmovement joints.

E. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.

F. Where welding is required, weld components in concealed locations to minimize distortion or discoloration of finish. Protect glazing surfaces from welding.

G. Seal joints watertight unless otherwise indicated.

H. Metal Protection:

1. Where aluminum is in contact with dissimilar metals, protect against galvanic action by painting contact surfaces with primer, applying sealant or tape, or installing nonconductive spacers as recommended by manufacturer for this purpose.
2. Where aluminum is in contact with concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

I. Install components to drain water passing joints, condensation occurring within framing members, and moisture migrating within glazed aluminum curtain wall to exterior.

J. Install components plumb and true in alignment with established lines and grades.

3.3 INSTALLATION OF OPERABLE UNITS

A. Install operable units level and plumb, securely anchored, and without distortion. Adjust weather-stripping contact and hardware movement to produce proper operation.

3.4 INSTALLATION OF GLAZING

A. Install glazing as specified in Section 088000 "Glazing."

3.5 INSTALLATION OF STRUCTURAL GLAZING

A. Prepare surfaces that will contact structural sealant in accordance with sealant manufacturer's written instructions, to ensure compatibility and adhesion. Preparation includes, but is not limited to, cleaning and priming surfaces.

B. Set glazing into framing in accordance with sealant manufacturer's and framing manufacturer's written instructions and standard practice. Use a spacer or backer as recommended by manufacturer.

C. Set glazing with proper orientation, so that coatings face exterior or interior as specified.

D. Hold glazing in place using temporary retainers of type and spacing recommended by manufacturer, until structural sealant joint has cured.

E. Apply structural sealant to completely fill cavity, in accordance with sealant manufacturer's and framing manufacturer's written instructions and in compliance with local codes.

F. Apply structural sealant at temperatures indicated by sealant manufacturer for type of sealant.

G. Allow structural sealant to cure in accordance with manufacturer's recommendations.

H. Clean and protect glass as indicated in Section 088000 "Glazing."

3.6 INSTALLATION OF WEATHERSEAL SEALANT

A. After structural sealant has completely cured, remove temporary retainers and insert backer rod between lites of glass, as recommended by sealant manufacturer.

B. Install weatherseal sealant to completely fill cavity, in accordance with sealant manufacturer's written instructions, to produce weatherproof joints.

3.7 INSTALLATION OF ALUMINUM-FRAMED ENTRANCE DOORS

A. Install entrance doors to produce smooth operation and tight fit at contact points.

1. Exterior Doors: Install to produce weathertight enclosure and tight fit at weather stripping.
2. Field-Installed Entrance Door Hardware: Install surface-mounted entrance door hardware in accordance with entrance door hardware manufacturers' written instructions using concealed fasteners to greatest extent possible.

3.8 ERECTION TOLERANCES

A. Install glazed aluminum curtain walls to comply with the following maximum tolerances:

1. Plumb: 1/8 inch in 10 feet; 1/4 inch in 40 feet.
2. Level: 1/8 inch in 20 feet; 1/4 inch in 40 feet.
3. Alignment:

    a. Where surfaces abut in line or are separated by reveal or protruding element up to 1/2 inch wide, limit offset from true alignment to 1/16 inch.
    b. Where surfaces are separated by reveal or protruding element from 1/2 to 1 inch wide, limit offset from true alignment to 1/8 inch.
    c. Where surfaces are separated by reveal or protruding element of 1 inch wide or more, limit offset from true alignment to 1/4 inch.

4. Location: Limit variation from plane to 1/8 inch in 12 feet; 1/2 inch over total length.

3.9 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Test Area: Perform tests on representative areas of glazed aluminum curtain walls and integrated exterior mockups.

C. Field Quality-Control Testing: Perform the following test on representative areas of glazed aluminum curtain walls and integrated exterior mockup.

1. Water-Spray Test: Before installation of interior finishes has begun, areas designated by Architect shall be tested in accordance with AAMA 501.2 and shall not evidence water penetration.

    a. Perform tests in test area as directed by Architect at 10, 35, and 70 percent completion.
    b. For each test, test a minimum of 200 lineal feet of joint.

2. Air Leakage: ASTM E783 at 1.0 times the rate specified for laboratory testing in "Performance Requirements" Article but not more than 0.06 cfm/sq. ft. at a static-air-pressure differential of 1.57 lbf/sq. ft..

    a. Perform a minimum of one test each in areas as directed by Architect at 10, 35, and 70 percent completion.

3. Water Penetration: ASTM E1105 at a minimum uniform static-air-pressure differential of 1.0 times the static-air-pressure differential specified for laboratory testing in "Performance Requirements" Article, but not less than 6.24 lbf/sq. ft., and shall not evidence water penetration.

    a. Perform a minimum of one test each in areas as directed by Architect at 10, 35, and 70 percent completion.

D. Glazed aluminum curtain walls will be considered defective if they do not pass tests and inspections.

1. In case of failed test, re-test failed test area and one additional test area of equal size.
2. Cost of subsequent testing required due to test failure to be paid for by the Contractor.

END OF SECTION

SECTION 08 56 53 - SECURITY WINDOWS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Vision security windows and doors.
2. Transaction windows.

1.2 COORDINATION

A. Coordinate installation of anchorages for security windows. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in adjacent construction.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, weights and finishes for window units.

B. Sustainable Design Submittals:

1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.
2. Environmental Product Declaration: For each product.
3. Health Product Declaration: For each product.
4. Sourcing of Raw Materials: Corporate sustainability report for each manufacturer.

C. Shop Drawings: For security windows.

1. Include plans, elevations, sections, and attachment details.
2. Full-size section details of framing members, including internal armoring, reinforcement, and stiffeners.
3. Location of weep holes.
4. Glazing details.

D. Shop Drawings: For transaction windows.

1. Include plans, elevations, sections, and attachment details.
2. Hardware for sliding window units.
3. Glazing details.
4. Details of deal tray and transaction counter as applicable.

E. Samples for Verification: For each type of exposed finish required, prepared on Samples of sizes indicated below:

1. Framing: 12-inch-long sections of frame members.

F. Cutaway Sample: Corner of security window, made from 12-inch lengths of full-size components, and showing details of the following:

1. Joinery.
2. Anchorage.
3. Glazing.
4. Flashing and drainage.

G. Delegated Design Submittal: For security windows indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Test Reports: For each type of security window and accessory indicated as ballistics and/or forced-entry resistant as indicated, for tests performed by a qualified testing agency.

C. Configuration Disclosure Drawing: For each type of forced-entry-resistant security window, complying with ASTM F1233.

D. Examination reports documenting inspections of substrates, areas, and conditions.

E. Anchor inspection reports documenting inspections of built-in and cast-in anchors.

F. Sample Warranty: For special warranty.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer for installation of units required for this Project.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Pack security windows in wood crates for shipment. Crate glazing separate from frames unless factory glazed.

B. Label security window packaging with drawing designation.

C. Store crated security windows on raised blocks to prevent moisture damage.

1.8 FIELD CONDITIONS

A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

1.9 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace security windows and doors that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures including deflections exceeding 1/4 inch.
b. Failure of welds.
c. Excessive air leakage.
d. Faulty operation of hardware.
e. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use.

2. Warranty Period: Ten years from date of Substantial Completion.

B. Special Finish Warranty, Factory-Applied Finishes: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of baked enamel, powder coat, or organic finishes within specified warranty period.

1. Deterioration includes, but is not limited to, the following:
a. Color fading more than 5 Delta E units when tested in accordance with ASTM D2244.
b. Chalking in excess of a No. 8 rating when tested in accordance with ASTM D4214.
c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Recycled Content of Steel Products: Provide products with postconsumer recycled content plus one-half of preconsumer recycled content to the extent required to comply with the minimum criteria specified in Section 01 81 13.33 “Sustainable Design Requirements – IGCC/ASHRAE 189.1.”

B. Recycled Content of Aluminum Components: Provide products with postconsumer recycled content plus one-half of preconsumer recycled content to the extent required to comply with the minimum criteria specified in Section 01 81 13.33 “Sustainable Design Requirements – IGCC/ASHRAE 189.1.”

C. Regional Materials: To the extent required to comply with the minimum criteria specified in Section 01 81 13.14 “Sustainable Design Requirements,” manufacture products within 100 miles of Project site from materials that have been extracted, harvested, or recovered, as well as manufactured, within 100 miles of Project site.

D. Attack Resistance: Provide units identical to those tested for compliance with requirements indicated, and as follows:

1. Ballistics Resistance, UL 752: Level 4 in accordance with UL 752 with the exception that the main entry doors comply with Level 3 in accordance with UL 752.
2. Forced-Entry Resistance, SD-STD-01.01: Five-minute protection level in accordance with SD-STD-01.01.

E. Structural Loads: Security windows withstand the effects of wind loads, with no permanent deformation or breakage of components within window assembly when tested in accordance with ASTM E330/E330M.

1. Wind Loads: As indicated on Drawings**.**

F. Air Leakage, Fixed Glazing and Framing: Provide windows with maximum air leakage through fixed glazing and framing areas of 0.06 cfm/sq. ft. of fixed wall area when tested in accordance with ASTM E283 at a minimum static-air-pressure difference of 6.24 lbf/sq. ft..

G. Water Penetration under Static Pressure, Fixed Glazing and Framing: Provide windows that do not evidence water penetration through fixed glazing and framing areas when tested in accordance with ASTM E331 at a minimum static-air-pressure difference of 20 percent of positive wind-load design pressure, but not less than 6.24 lbf/sq. ft..

H. Energy Performance: Provide windows with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below:

1. Thermal Transmittance (U-Factor): Glazing and framing areas as a whole have U-factor of not more than 0.38 Btu/sq. ft. x h x deg F as determined in accordance with NFRC 100.
2. Solar Heat-Gain Coefficient (SHGC): Glazing and framing areas as a whole have SHGC of no greater than 0.36 as determined in accordance with NFRC 200.

2.2 VISION SECURITY CURTAIN WALL, CW-3

A. Provide vision security windows with framing on four sides and no operable sash or ventilator.

1. Basis-of-Design Product: Subject to compliance with requirements, provide **Insulgard Security Products; Bulletblock HP600** or a comparable product by one of the following:

a. Armortex.
b. Krieger Specialty Products Company.
c. Norshield Security Products, LLC.
d. Ross Technology Company.

B. Framing: Fabricate perimeter framing, mullions, and glazing stops from aluminum as follows:

1. Profile:

a. Face Dimension: 2-1/2 inches.

2. Depth: Nominally 6 inches.
3. Provide thermally broken construction for aluminum framing.

C. Glazing and Glazing Materials: Comply with requirements in Section 08 88 53 "Security Glazing."

D. Materials:

1. Aluminum Extrusions: ASTM B221. Provide alloy and temper recommended by manufacturer for strength, corrosion resistance, and application of required finish, but not less than 22,000-psi ultimate tensile strength.
2. Aluminum Sheet and Plate: ASTM B209.

E. Finish: High-performance organic finish.

1. Color and Gloss: As preselected and indicated in Finish Schedule.

2.3 INTERIOR VISION SECURITY WINDOWS

A. Provide vision security windows with framing on four sides and no operable sash or ventilator.

1. Basis-of-Design Product: Subject to compliance with requirements, provide **Insulgard Security Products; Bulletblock 44-250** or a comparable product by one of the following:

a. Armortex.
b. Krieger Specialty Products Company.
c. Norshield Security Products, LLC.
d. Ross Technology Company.

B. Framing: Fabricate perimeter framing, mullions, and glazing stops from aluminum as follows:

1. Profile: Narrow, with minimum face dimension indicated.

a. Minimum Face Dimension: 1-1/2 inches.

2. Depth: Manufacturer's standard.

C. Glazing and Glazing Materials: Comply with requirements in Section 088853 "Security Glazing."

D. Materials:

1. Aluminum Extrusions: ASTM B221. Provide alloy and temper recommended by manufacturer for strength, corrosion resistance, and application of required finish, but not less than 22,000-psi ultimate tensile strength.
2. Aluminum Sheet and Plate: ASTM B209.

2.4 SECURITY CURTAIN WALL DOOR

A. Provide vision security windows with framing on four sides and no operable sash or ventilator.

1. Basis-of-Design Product: Subject to compliance with requirements, provide **Insulgard Security Products; Bulletblock HP500** or a comparable product by one of the following:

a. Armortex.
b. Habersham Metal Products Company.
c. Krieger Specialty Products Company.
d. Norshield Security Products, LLC.
e. Ross Technology Company.

B. Door Construction: 3-5/8 inch overall thickness, with minimum 0.25-inch-thick, extruded-aluminum tubular rail and stile members with corner joinery consisting of extruded and keyed aluminum splines with continuous 1/2-inch-diameter steel tie rods at the top and bottom rails.

1. Door Design: Wide stile; 5-inch nominal width with 10-inch bottom rail.
2. Glazing Stops and Gaskets: 1-1/2 inch square face, snap-on, extruded-aluminum stops and preformed gaskets.

a. Provide nonremovable glazing stops on outside of door.

3. Armor: 5/16 inch steel armor plate.

C. Glazing and Glazing Materials: Comply with requirements in Section 08 88 53 "Security Glazing."

D. Materials:

1. Aluminum Extrusions: ASTM B221. Provide alloy and temper recommended by manufacturer for strength, corrosion resistance, and application of required finish, but not less than 22,000-psi ultimate tensile strength.
2. Aluminum Sheet and Plate: ASTM B209.

E. Finish: High-performance organic finish.

1. Color and Gloss: As preselected and indicated in Finish Schedule.

2.5 FIXED, TRANSACTION WINDOWS

A. Provide fixed, transaction windows with recessed deal tray, as indicated, allowing transfer of currency and documents.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Armortex.
b. C.R. Laurence Co., Inc.
c. Chicago Bullet Proof Systems.
d. Krieger Specialty Products Company.
e. National Bullet Proof, Inc.

f. Norshield Products Group.
g. Ross Technology Corporation.
h. SABIC Innovative Plastics IP BV.

B. Configuration: One fixed-glazed panel.

C. Framing: Fabricate perimeter framing and glazing stops from extruded aluminum as follows:

1. Profile: Manufacturer's standard, with minimum face dimension indicated.

a. Minimum Face Dimension: 1-1/4 inches.

2. Depth: Manufacturer's standard.

D. Channel-Frame Head and Jamb: Designed with glazing spacers for voice communication by speech at normal volume.

E. Glazing and Glazing Materials: Comply with requirements in Section 08 8000 "Glazing."

F. Glazing Meeting Edges: Polished glazing.

G. Materials:

1. Aluminum Extrusions: ASTM B221. Provide alloy and temper recommended by manufacturer for strength, corrosion resistance, and application of required finish, but not less than 22,000-psi ultimate tensile strength.
2. Aluminum Sheet and Plate: ASTM B209.

H. Finish: Baked-enamel or powder-coated in custom color selected by Architect.

2.6 FABRICATION

A. General: Fabricate security and transaction windows to provide a complete system for assembly of components and anchorage of window units.

1. Provide transaction window units that are re-glazable from the private side without dismantling the public side of framing.
2. Prepare transaction windows for field glazing unless pre-glazing at the factory is indicated.

B. Provide weep holes and internal water passages for exterior security windows to conduct infiltrating water to the exterior.

C. Thermally Improved or Thermally Broken Construction: Fabricate framing with an integral, concealed, low-conductance thermal barrier, located between exterior materials and members exposed on interior in a manner that eliminates direct metal-to-metal contact.

D. Framing: Miter or cope corners the full depth of framing; weld and dress smooth.

1. Fabricate framing with manufacturer's standard, internal opaque armoring in thicknesses required for security windows to comply with ballistics-resistance performance indicated.

E. Glazing Stops: Finish glazing stops to match transaction window framing.

1. Public-Side (Exterior) Glazing Stops: Welded or integral to framing.
2. Private-Side (Interior) Glazing Stops: Removable, coordinated with glazing indicated.

F. Welding: Weld components to comply with referenced AWS standard. To greatest extent possible, weld before finishing and in concealed locations to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.

G. Metal Protection: Separate dissimilar metals to protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape recommended by manufacturer for this purpose.

2.7 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM/NOMMA 500 for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.8 ALUMINUM FINISHES

A. High-Performance Organic Finish, Two-Coat PVDF: Fluoropolymer finish complying with AAMA 2605 and containing not less than 70 percent PVDF resin by weight in color coat.

1. Color and Gloss: As preselected and indicated in Finish Schedule.

B. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of 1.5 mils. Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

1. Color: As preselected and indicated in Finish Schedule.

2.9 ACCESSORIES

A. Recessed Deal Trays: Formed from stainless steel; fabricated in curved shape with exposed flanges for recessed installation into horizontal surface.

1. Clear Opening Size: 16 inches wide by 11 inches deep by 1-1/2 inches high, unless indicated otherwise on Drawings.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of security windows.

B. Examine roughing-in for embedded and built-in anchors to verify actual locations of security window connections before security window installation.

C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of security windows.

D. Inspect built-in and cast-in anchor installations, before installing security windows, to verify that anchor installations comply with requirements. Prepare inspection reports.

1. Remove and replace anchors where inspections indicate that they do not comply with specified requirements. Reinspect after repairs or replacements are made.
2. Perform additional inspections to determine compliance of replaced or additional work. Prepare anchor inspection reports.

E. For factory-installed glazing materials whose orientation (secure or attack side) is critical for performance, verify installation orientation.

F. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Coordination: Furnish layouts for cast-in-place anchors, clips, and other security window anchors whose installation is specified in other Sections.

1. Furnish cast-in-place anchors and similar devices to other trades for installation well in advance of time needed for coordinating other work.

3.3 INSTALLATION

A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing security windows to in-place construction. Include threaded fasteners for inserts, security fasteners, and other connectors.

1. Install an attached or integral flange to secure side of security windows extending over rough-in opening gap so that gap has same forced-entry-resistance and ballistics-resistance performance as security window.

B. Glazed Framing: Provide gasket-glazed framing. Comply with installation requirements in Section 088853 "Security Glazing."

C. Removable Glazing Stops and Trim: Fasten components with security fasteners.

D. Voice-Communication-Type Framing for Transaction Window: Attach removable glass spacers to jambs and head of glazing, located not more than 6 inches from each corner and spaced not more than 12 inches o.c.

E. Fasteners: Install security windows using fasteners recommended by manufacturer with head style appropriate for installation requirements, strength, and finish of adjacent materials.

F. Sealants: Comply with requirements in Section 079200 "Joint Sealants" for installing sealants, fillers, and gaskets.

1. Set continuous sill members and flashing in a full sealant bed to provide weathertight construction unless otherwise indicated.
2. Seal frame perimeter with sealant to provide weathertight construction unless otherwise indicated.

G. Metal Protection: Where dissimilar metals will contact each other, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape recommended in writing by manufacturer for this purpose. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

3.4 FIELD QUALITY CONTROL

A. Inspect installed products to verify compliance with requirements. Prepare inspection reports and indicate compliance with and deviations from the Contract Documents.

B. Perform additional inspections to determine compliance of replaced or additional work. Prepare inspection reports.

C. Prepare field quality-control certification that states installed products and their installation comply with requirements in the Contract Documents.

3.5 CLEANING AND PROTECTION

A. Clean surfaces promptly after installation of security windows. Take care to avoid damaging the finish. Remove excess glazing and sealant compounds, dirt, and other substances.

B. Clean glass of pre-glazed security windows and doors promptly after installation. Comply with requirements in Section 088853 "Security Glazing" for cleaning and maintenance.

C. Provide temporary protection to ensure that security windows are without damage at time of Substantial Completion.

END OF SECTION

SECTION 08 63 00 - METAL-FRAMED SKYLIGHTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes skylights with metal framing.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for metal-framed skylights.

B. Sustainable Design Submittals:

1. Product Data: For sealants, indicating VOC content.
2. Laboratory Test Reports: For sealants, indicating compliance with requirements for low-emitting materials.

C. Shop Drawings: For metal-framed skylights.

1. Include plans, elevations, sections, and attachment details.
2. Indicate structural loadings and reactions to be transmitted to supporting curbs.
3. Include details of provisions for assembly expansion and contraction and for draining moisture within the assembly to the exterior.
4. Include full-size isometric details of each vertical-to-horizontal intersection of assembly, showing the following:

a. Joinery including concealed welds.
b. Anchorage.
c. Expansion provisions.
d. Glazing.
e. Flashing and drainage.

D. Samples for Verification: For each type of exposed finish required, in manufacturer's standard sizes.

E. Fabrication Sample: Of each framing intersection of assemblies, made from 12-inch lengths of full-size components and showing details of the following:

1. Joinery including concealed welds.

2. Anchorage.
3. Expansion provisions.
4. Glazing.
5. Flashing and drainage.

F. Delegated Design Submittal: For metal-framed skylights indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Compatibility and Adhesion Test Reports: For structural-sealant-glazed skylights, test reports from sealant manufacturer indicating that joint sealants have been tested for each material that will come in contact with sealants.

C. Product Test Reports: For metal-framed skylights, for tests performed by a qualified testing agency.

D. Sample Warranties: For special warranties.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For metal-framed skylights to include in maintenance manuals.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of metal-framed skylights required for this Project.

B. Structural-Sealant Glazing: Comply with recommendations in ASTM C1401, "Guide for Structural Sealant Glazing," for joint design and quality-control procedures.

1. Joint designs are reviewed and approved by structural-sealant manufacturer.
2. Quality-control program development and reporting comply with ASTM C1401 recommendations for material qualification procedures, preconstruction sealant-testing program, and procedures and intervals for fabrication and installation reviews and checks.
3. Perform manufacturer's standard tests for compatibility and adhesion of sealants with each material that will come in contact with sealants.

1.7 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of metal framed skylights that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures including, but not limited to, excessive deflection.
b. Noise or vibration caused by thermal movements.
c. Deterioration of metals and other materials beyond normal weathering.
d. Adhesive or cohesive sealant failures.
e. Water leakage.

2. Warranty Period: 10 years from date of Substantial Completion.

B. Special Finish Warranty, Factory-Applied Finishes: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of baked enamel, powder coat, or organic finishes within specified warranty period.

1. Deterioration includes, but is not limited to, the following:

a. Color fading more than 5 Delta E units when tested in accordance with ASTM D2244.
b. Chalking in excess of a No. 8 rating when tested in accordance with ASTM D4214.
c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design metal-framed skylights.

B. Structural Loads: As indicated on Drawings.

C. Deflection of Framing Members: At design wind pressure, as follows:

1. Deflection Normal to Glazing Plane: Limited to edge of glass in a direction perpendicular to glass plane not exceeding L/175 of the glass edge length for each individual glazing lite or an amount that restricts edge deflection of individual glazing lites to 3/4 inch, whichever is less.
2. Deflection Parallel to Glazing Plane: Limited to amount not exceeding that which reduces glazing bite to less than 75 percent of design dimension and that which reduces edge clearance between framing members and glazing or other fixed components to less than 1/8 inch.

D. Lateral Bracing of Framing Members: Compression flanges of flexural members are laterally braced by cross members with minimum depth equal to 50 percent of flexural member that is braced. Glazing does not provide lateral support.

E. Structural-Test Performance: Metal-framed skylights tested in accordance with ASTM E330, as follows:

1. When tested at positive and negative wind-load design pressures, assemblies do not evidence deflection exceeding specified deflection limits.

2. When tested at 150 percent of positive and negative wind-load design pressures, assemblies, including anchorage, do not evidence material failures, structural distress, and permanent deformation of main framing members exceeding 0.2 percent of span.
3. Test Durations: As required by design wind velocity, but not less than 10 seconds.

F. Air Leakage: Metal-framed skylights with maximum air leakage through fixed glazing and framing areas of 0.06 cfm/sq. ft. of when tested in accordance with ASTM E283 at a minimum static-air-pressure difference of 6.24 lbf/sq. ft..

G. Water Penetration under Static Pressure: Metal-framed skylights that do not evidence water penetration through fixed glazing and framing areas when tested in accordance with ASTM E331 at a minimum static-air-pressure difference of 20 percent of positive wind-load design pressure, but not less than 6.24 lbf/sq. ft..

H. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.

1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

I. Condensation Resistance: Metal-framed skylights with fixed glazing and framing areas having condensation-resistance factor (CRF) of not less than 53 when tested in accordance with AAMA 1503.

J. Structural Sealant: Capable of withstanding tensile and shear stresses imposed without failing adhesively or cohesively. When tested for preconstruction adhesion and compatibility, cohesive failure of sealant occurs before adhesive failure.

K. Energy Performance: Provide metal-framed skylights with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below:

1. Thermal Transmittance (U-Factor): Fixed glazing and framing areas have U-factor of not more than 0.50 Btu/sq. ft. x h x deg F as determined in accordance with NFRC 100.
2. Solar Heat Gain Coefficient: Fixed glazing and framing areas have a solar heat gain coefficient of no greater than 0.4 as determined in accordance with NFRC 200.

2.2 METAL-FRAMED SKYLIGHTS

A. Metal-Framed Skylights: Glazed skylight assemblies supported by aluminum framing.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Acurlite Structural Skylights, Inc.
b. Kawneer Company, Inc.; Arconic Corporation.
c. Linel; Mestek, Inc.
d. OldCastle BuildingEnvelope (OBE).
e. Super Sky Products Enterprises, LLC.

B. Aluminum Framing Systems: Manufacturer's standard extruded-aluminum members of thickness required and reinforced as required to support imposed loads.

C. Aluminum: Alloy and temper as recommended in writing by manufacturer for type of use and finish indicated.

1. Sheet and Plate: ASTM B209.
2. Extruded Bars, Rods, Profiles, and Tubes: ASTM B221.
3. Extruded Structural Pipe and Tubes: ASTM B429/B429M.
4. Structural Profiles: ASTM B308/B308M.

D. Pressure Caps: Manufacturer's standard aluminum components that mechanically retain glazing.

1. Include snap-on aluminum trim that conceals fasteners.

E. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning skylight components.

F. Fasteners and Accessories: Manufacturer's standard, corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.

1. At pressure caps, use ASTM A193/A193M stainless steel screws.
2. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
3. Reinforce members as required to receive fastener threads.

G. Anchor Bolts: ASTM A307, Grade A, galvanized steel.

H. Concealed Flashing: Manufacturer's standard, corrosion-resistant, nonstaining, nonbleeding flashing compatible with adjacent materials.

I. Exposed Flashing and Closures: Manufacturer's standard aluminum components not less than 0.040 inch thick.

J. Framing Sealants: As recommended in writing by manufacturer.

1. Verify sealant has a VOC content of 250 g/L or less.
2. Verify sealant complies with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

K. Corrosion-Resistant Coating: Cold-applied asphalt mastic, compounded for 15-mil dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

2.3 GLAZING

A. Glazing: As specified in Section 08 80 00 "Glazing."

B. Glazing Gaskets: Manufacturer's standard sealed-corner pressure-glazing system of black, resilient elastomeric glazing gaskets, setting blocks, and shims or spacers.

C. Spacers and Setting Blocks: Manufacturer's standard elastomeric types.

D. Glazing Sealants: As recommended in writing by manufacturer**.**

1. Verify sealant has a VOC content of 250 g/L or less.
2. Verify sealant complies with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

E. Structural Glazing Sealants:

1. Structural Sealant: ASTM C1184, neutral-curing silicone formulation compatible with system components with which it comes in contact, specifically formulated and tested for use as structural sealant, and approved by structural-sealant manufacturer for use in metal-framed skylights indicated.

    a. Color: Black.

2. Weatherseal Sealant: ASTM C920 for Type S, Grade NS, Class 50, Uses NT, G, A, and O; neutral-curing silicone formulation compatible with structural sealant and other components with which it comes in contact; and recommended in writing by structural- and weatherseal-sealant and metal-framed skylight manufacturers for this use.

    a. Color: Matching structural sealant.

3. Verify sealant has a VOC content of 250 g/L or less.
4. Verify sealant complies with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
5. Bond-Breaker Tape: Manufacturer's standard tetrafluoroethylene-fluorocarbon or polyethylene material to which sealants will not develop adhesion.

2.4 FABRICATION

A. Where practical, fit and assemble metal-framed skylights in manufacturer's plant. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.

B. Fabricate aluminum components that, when assembled, have the following characteristics:

1. Profiles that are sharp, straight, and free of defects or deformations.
2. Accurately fitted joints with ends coped or mitered.
3. Internal guttering systems or other means to drain water passing joints and moisture migrating within skylight to exterior.
4. Physical and thermal isolation of glazing from framing members.
5. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.

C. Fabricate aluminum sill closures with weep holes and for installation as continuous component.

D. Reinforce aluminum components as required to receive fastener threads.

E. Structural-Sealant-Glazed, Metal-Framed Skylights: Prepare surfaces that will contact structural sealant according to structural-sealant manufacturer's written instructions to ensure compatibility and adhesion. Preparation includes, but is not limited to, cleaning and priming surfaces.

F. After fabrication, clearly mark components to identify their locations in Project in accordance with Shop Drawings.

2.5 ALUMINUM FINISHES

A. High-Performance Organic Finish, Two-Coat PVDF: Fluoropolymer finish complying with AAMA 2605 and containing not less than 70 percent PVDF resin by weight in color coat.

1. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
2. Color and Gloss: As preselected and indicated in Finish Schedule.

2.6 SOURCE QUALITY CONTROL

A. Structural-Sealant Glazing: Perform quality-control procedures complying with ASTM C1401 recommendations including, but not limited to, material qualification procedures, sealant testing, and fabrication reviews and checks.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Comply with manufacturer's written instructions.

1. Do not install damaged components.
2. Fit joints between aluminum components to produce hairline joints free of burrs and distortion.
3. Rigidly secure nonmovement joints.
4. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.
5. Seal joints watertight unless otherwise indicated.

B. Metal Protection: Where aluminum will contact dissimilar materials, protect against galvanic action by painting contact surfaces with protective coating or by installing nonconductive spacers as recommended in writing by manufacturer for this purpose.

C. Install continuous aluminum sill closure with weatherproof expansion joints and locked and sealed or welded corners. Locate weep holes at rafters.

D. Install components to drain water passing joints, and moisture migrating within skylight to exterior.

E. Install components plumb and true in alignment with established lines and elevations.

F. Glazing: Install glazing as specified in Section 088000 "Glazing."

G. Structural-Sealant Glazing:

1. Prepare surfaces that will contact structural sealant according to structural-sealant manufacturer's written instructions to ensure compatibility and adhesion. Preparation includes, but is not limited to, cleaning and priming surfaces.
2. Install weatherseal sealant according to weatherseal-sealant manufacturer's written instructions to produce weatherproof joints. Install joint filler behind weatherseal sealant as recommended in writing by weatherseal-sealant manufacturer.

H. Erection Tolerances: Install metal-framed skylights to comply with the following maximum tolerances:

1. Alignment: Limit offset from true alignment to 1/32 inch where surfaces abut in line, edge to edge, at corners, or where a reveal or protruding element separates aligned surfaces by less than 3 inches; otherwise, limit offset to 1/8 inch.
2. Location and Plane: Limit variation from true location and plane to 1/8 inch in 12 feet but no greater than 1/2 inch over total length.

3.3 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

1. Water-Spray Test: Before installation of interior finishes has begun, skylights are tested in accordance with AAMA 501.2 and do not evidence water penetration.

B. Repair or remove work where test results and inspections indicate that it does not comply with specified requirements.

C. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

D. Prepare test and inspection reports.

3.4 CLEANING AND PROTECTION

A. Clean exposed surfaces immediately after installing skylights. Avoid damaging protective coatings and finishes. Remove excess sealants, glazing materials, dirt, and other substances.

B. Remove and replace glass that has been broken, chipped, cracked, abraded, or damaged during construction period.

C. Protect skylights from contact with contaminating substances resulting from construction operations. If contaminating substances do contact skylight surfaces, remove contaminants immediately according to manufacturer's written instructions.

END OF SECTION

This page is intentionally left blank.

SECTION 08 71 00 - DOOR HARDWARE

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Hardware for wood, aluminum, and hollow metal doors.

B. Hardware for fire-rated doors.

C. Electrically operated and controlled hardware.

D. Lock cylinders for doors with balance of hardware specified in other sections.

E. Thresholds.

F. Smoke and draft control seals.

G. Weatherstripping and gasketing.

1.2 RELATED REQUIREMENTS

A. Section 064100 - Architectural Wood Casework: Cabinet hardware.

B. Section 080671 - Door Hardware Schedule: Schedule of door hardware sets.

C. Section 081113 - Hollow Metal Doors and Frames.

D. Section 081116 - Aluminum Doors and Frames.

E. Section 081213 - Hollow Metal Frames.

F. Section 081416 - Flush Wood Doors.

G. Section 081433 - Stile and Rail Wood Doors.

H. Section 083323 - Overhead Coiling Doors: Door hardware, except cylinders.

I. Section 084313 - Aluminum-Framed Storefronts: Door hardware, except as noted in section.

J. Section 281000 - Access Control: Electronic access control devices.

K. Section 284600 - Fire Detection and Alarm: Electrical connection to activate door closers and release magnetic holders.

1.3 REFERENCE STANDARDS

A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design 2010.

B. BHMA A156.1 - Standard for Butts and Hinges 2021.

C. BHMA A156.3 - Exit Devices 2020.

D. BHMA A156.4 - Door Controls - Closers 2019.

E. BHMA A156.5 - Cylinders and Input Devices for Locks 2020.

F. BHMA A156.6 - Standard for Architectural Door Trim 2021.

G. BHMA A156.7 - Template Hinge Dimensions 2016.

H. BHMA A156.8 - Door Controls - Overhead Stops and Holders 2021.

I. BHMA A156.13 - Mortise Locks & Latches Series 1000 2017.

J. BHMA A156.15 - Release Devices - Closer Holder, Electromagnetic and Electromechanical 2021.

K. BHMA A156.16 - Auxiliary Hardware 2018.

L. BHMA A156.18 - Materials and Finishes 2020.

M. BHMA A156.19 - Power Assist and Low Energy Power Operated Swinging Doors 2019.

N. BHMA A156.21 - Thresholds 2019.

O. BHMA A156.22 - Standard for Gasketing 2021.

P. BHMA A156.25 - Electrified Locking Devices 2018.

Q. BHMA A156.26 - Standard for Continuous Hinges 2021.

R. BHMA A156.28 - Recommended Practices For Mechanical Keying Systems 2018.

S. BHMA A156.115 - Hardware Preparation In Steel Doors And Steel Frames 2016.

T. BHMA A156.115W - Hardware Preparation in Wood Doors with Wood or Steel Frames 2006.

U. DHI (H&S) - Sequence and Format for the Hardware Schedule 2019.

V. DHI (KSN) - Keying Systems and Nomenclature 2019.

W. DHI (LOCS) - Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames 2004.

X. DHI WDHS.3 - Recommended Locations for Architectural Hardware for Flush Wood Doors 1993; also in WDHS-1/WDHS-5 Series, 1996.

Y. ICC A117.1 - Accessible and Usable Buildings and Facilities 2017.

Z. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

AA. NFPA 80 - Standard for Fire Doors and Other Opening Protectives 2022.

BB. NFPA 101 - Life Safety Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

CC. NFPA 105 - Standard for Smoke Door Assemblies and Other Opening Protectives 2022.

DD. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies 2022.

EE. UL (DIR) - Online Certifications Directory Current Edition.

FF. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies Current Edition, Including All Revisions.

GG. UL 1034 - Standard for Safety Burglary-Resistant Electrical Locking Mechanisms 2015.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordinate the manufacture, fabrication, and installation of products that door hardware is installed on.

B. Sequence installation to ensure facility services connections are achieved in an orderly and expeditious manner.

C. Access control coordination meeting.

D. Preinstallation Meeting: Convene a preinstallation meeting four weeks prior to commencing work of this section; require attendance by affected installers and the following:

1. Architect.

2. Installer's Architectural Hardware Consultant (AHC).

3. Hardware Installer.

4. Owner's Security Consultant.

E. Furnish templates for door and frame preparation to manufacturers and fabricators of products requiring internal reinforcement for door hardware.

F. Keying Requirements Meeting:

1.5 SUBMITTALS

A. See Section 013000 - Administrative Requirements for submittal procedures.

B. Product Data: Manufacturer's catalog literature for each type of hardware, marked to clearly show products to be furnished for this project, and includes construction details, material descriptions, finishes, and dimensions and profiles of individual components.

C. Shop Drawings - Door Hardware Schedule: A detailed listing that includes each item of hardware to be installed on each door.

1. Prepared by or under supervision of Architectural Hardware Consultant (AHC).

2. Comply with DHI (H&S) using door numbering scheme and hardware set numbers as indicated in Contract Documents.

a. Submit in vertical format.

3. List groups and suffixes in proper sequence.

4. Include complete description for each door listed.

5. Include manufacturer's and product names, and catalog numbers; include functions, types, styles, sizes and finishes of each item.

6. Include account of abbreviations and symbols used in schedule.

D. Shop Drawings - Electrified Door Hardware: Include diagrams for power, signal, and control wiring for electrified door hardware that include details of interface with building safety and security systems. Provide elevations and diagrams for each electrified door opening as follows:

1. Prepared by or under supervision of Architectural Hardware Consultant (AHC) and Electrified Hardware Consultant (EHC).

2. Elevations: Include front and back elevations of each door opening showing electrified devices with connections installed and an operations narrative describing how opening operates from either side at any given time.

3. Diagrams: Include point-to-point wiring diagrams that show each device in door opening system with related colored wire connections to each device.

E. Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.

F. Maintenance Data: Include data on operating hardware, lubrication requirements, and inspection procedures related to preventative maintenance.

1. Include manufacturer's parts lists and templates.

2. Bitting List: List of combinations as furnished.

G. Keying Schedule:

1. Submit three (3) copies of Keying Schedule in compliance with requirements established during Keying Requirements Meeting unless otherwise indicated.

H. Warranty: Submit manufacturer's warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

I. Maintenance Materials and Tools: Furnish the following for Owner's use in maintenance of project.

1. See Section 016000 - Product Requirements, for additional provisions.

2. Tools: One set of each special wrench or tool applicable for each different or special hardware component, whether supplied by hardware component manufacturer or not.

1.6 QUALITY ASSURANCE

A. Standards for Fire-Rated Doors: Maintain one copy of each referenced standard on site, for use by Architect and Contractor.

B. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum three years of documented experience.

C. Installer Qualifications: Company specializing in performing work of the type specified for commercial door hardware with at least three years of documented experience.

D. Supplier Qualifications: Company with certified Architectural Hardware Consultant (AHC) and Electrified Hardware Consultant (EHC) to assist in work of this section.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Package hardware items individually; label and identify each package with door opening code to match door hardware schedule.

1.8 WARRANTY

A. See Section 017800 - Closeout Submittals for additional warranty requirements.

B. Manufacturer Warranty: Provide manufacturer warranty against defects in material and workmanship for period indicated, from Date of Substantial Completion. Complete forms in Owner's name and register with manufacturer.

1. Closers: Ten years, minimum.

2. Exit Devices: Five years, minimum.

3. Locksets and Cylinders: Ten years, minimum.

PART 2 PRODUCTS

2.1 GENERAL REQUIREMENTS

A. Provide specified door hardware as required to make doors fully functional, compliant with applicable codes, and secure to extent indicated.

B. Provide individual items of single type, of same model, and by same manufacturer.

C. Closers:

1. Provide door closer on each exterior door, unless otherwise indicated.

2. Provide door closer on each fire-rated and smoke-rated door.

3. Spring hinges are not an acceptable self-closing device, unless otherwise indicated.

D. Overhead Stops and Holders (Door Checks):

1. Provide stop for every swinging door, unless otherwise indicated.

2. Overhead Stop is not required if positive stop feature is specified for door closer; positive stop feature of door closer is not an acceptable substitute for a stop, unless otherwise indicated.

3. Overhead stop is not required if a floor or wall stop has been specified for the door.

E. Drip Guards: Provide at head of outswinging exterior doors unless protected by roof or canopy directly overhead.

F. Thresholds:

1. Exterior Applications: Provide at each exterior door, unless otherwise indicated.

G. Smoke and Draft Control Seals:

1. Provide gasketing for smoke and draft control doors (Indicated as "S" on Drawings) that complies with local codes, requirements of assemblies tested in accordance with UL 1784.

H. Weatherstripping and Gasketing:

1. Provide weatherstripping on each exterior door at head, jambs, and meeting stiles of door pairs, unless otherwise indicated.

2. Provide door bottom sweep on each exterior door, unless otherwise indicated.

I. Electrically Operated and/or Controlled Hardware: Provide necessary power supplies, power transfer hinges, relays, and interfaces as required for proper operation; provide wiring between hardware and control components and to building power connection in compliance with NFPA 70.

J. Fasteners:

1. Provide fasteners of proper type, size, quantity, and finish that comply with commercially recognized standards for proposed applications.

a. Aluminum fasteners are not permitted.

b. Provide phillips flat-head screws with heads finished to match door surface hardware unless otherwise indicated.

2. Provide machine screws for attachment to reinforced hollow metal and aluminum frames.

a. Self-drilling (Tek) type screws are not permitted.

3. Provide stainless steel machine screws and lead expansion shields for concrete and masonry substrates.

4. Provide wall grip inserts for hollow wall construction.

5. Fire-Resistance-Rated Applications: Comply with NFPA 80.

a. Provide wood or machine screws for hinges mortised to doors or frames, strike plates to frames, and closers to doors and frames.

b. Provide steel through bolts for attachment of surface mounted closers, hinges, or exit devices to door panels unless proper door blocking is provided.

2.2 PERFORMANCE REQUIREMENTS

A. Provide door hardware products that comply with the following requirements:

1. Applicable provisions of federal, state, and local codes.

2. Accessibility: ADA Standards and ICC A117.1.

3. Fire-Resistance-Rated Doors: NFPA 80, listed and labeled by qualified testing agency for fire protection ratings indicated, based on testing at positive pressure in accordance with NFPA 252 or UL 10C.

4. Hardware on Fire-Resistance-Rated Doors: Listed and classified by UL (DIR), ITS (DIR), or testing firm acceptable to authorities having jurisdiction as suitable for application indicated.

5. Hardware for Smoke and Draft Control Doors (Indicated as "S" on Drawings): Provide door hardware that complies with local codes, and requirements of assemblies tested in accordance with UL 1784.

6. Hardware Preparation for Steel Doors and Steel Frames: BHMA A156.115.

7. Hardware Preparation for Wood Doors with Wood or Steel Frames: BHMA A156.115W.

8. Products Requiring Electrical Connection: Listed and classified by UL (DIR) as suitable for the purpose specified.

2.3 HINGES

A. Manufacturers: Conventional butt hinges.

1. BEST; dormakaba Group: www.bestaccess.com/#sle.

2. Mckinney.

3. Ives Hardware.

B. Properties:

1. Butt Hinges: As applicable to each item specified.

a. Standard Weight Hinges: Minimum of two (2) permanently lubricated non-detachable bearings.

b. Heavy Weight Hinges: Minimum of four (4) permanently lubricated bearings on heavy weight hinges.

c. Template screw hole locations.

d. Bearings: Exposed fully hardened bearings.

e. Bearing Shells: Shapes consistent with barrels.

f. UL 10C listed for fire-resistance-rated doors.

2. Continuous Hinges: As applicable to each item specified.

3. Manufactures: Best Access, Pemko, Ives Hardware

a. Geared Continuous Hinges: As applicable to each item specified.

1) Non-handed.

2) Anti-spinning through-fastener.

3) UL 10C listed for fire-resistance-rated doors.

(a) Metal Door Installation: Rated up to 90 minutes.

(b) Wood Door Installation: Rated up to 60 minutes.

4) Sufficient size to permit door to swing 180 degrees

C. Sizes: See Door Hardware Schedule.

1. Hinge Widths: As required to clear surrounding trim.

2. Sufficient size to allow 180 degree swing of door.

D. Finishes: See Door Hardware Schedule.

1. Fully polish hinges; front, back, and barrel.

E. Grades:

1. Butt Hinges: Comply with BHMA A156.1 and BHMA A156.7 for templated hinges.

2. Comply with BHMA A156.18 Materials and Finishes.

3. Continuous Hinges: Comply with BHMA A156.26, Grade 1.

F. Material: Base metal as indicated for each item by BHMA material and finish designation.

G. Types:

1. Butt Hinges: Include full mortise hinges.

2. Continuous Hinges: Include geared hinges.

H. Options: As applicable to each item specified.

I. Quantities:

1. Butt Hinges: Three (3) hinges per leaves up to 90 inches (2286 mm) in height. Add one (1) for each additional 30 inches (762 mm) in height or fraction thereof.

a. Hinge weight and size unless otherwise indicated in hardware sets:

1) For doors up to 36 inches (914 mm) wide and up to 1-3/4 inches (44.5 mm) thick provide hinges with a minimum thickness of 0.134 inch (3.4 mm) and a minimum of 4-1/2 inches (114 mm) in height.

2) For doors from 36 inches (914 mm) wide up to 42 inches (1067 mm) wide and up to 1-3/4 inches (44.5 mm) thick provide hinges with a minimum thickness of 0.145 inch (3.7 mm) and a minimum of 4-1/2 inches (114 mm) in height.

3) For doors from 42 inches (1067 mm) wide up to 48 inches (1219 mm) wide and up to 1-3/4 inches (44.5 mm) thick provide hinges with a minimum thickness of 0.180 inch (4.6 mm) and a minimum of 5 inches (127 mm) in height.

4) For doors greater than 1-3/4 inches (44.5 mm) thick provide hinges with a minimum thickness of 0.180 inch (4.6 mm) and a minimum of 5 inches (127 mm) in height.

2. Continuous Hinges: One per door leaf.

J. Applications: At swinging doors.

1. Provide non-removable pins at out-swinging doors with locking hardware and all exterior doors.

K. Products:

1. Butt Hinges:

a. Ball Bearing, Five (5) Knuckle.

2. Continuous Hinges:

a. Aluminum geared hinges.

2.4 FLOOR CLOSERS

A. Manufacturers:

1. dormakaba; dormakaba Group:

2. Rixon

3. Equal as approved by architect.

B. Properties:

1. Employing a cam-and-roller mechanism.

2. Capable of controlling interior or exterior doors weighing up to 260 lbs (118 kg) and measuring up to 36 inches (914 mm) wide exterior doors and 42 inches (1067 mm) wide interior doors.

3. Mechanical Back Check: At 70 degrees.

4. Dual Valve Adjustment: Controlling closing speed from 175 degrees.

5. Adjustment Within the Concrete Case: Allowing lateral and longitudinal adjustment of 1/4 inch (6.3 mm) and vertical height adjustment of 5/32 inch (4 mm).

6. Field Interchangeable Spindles: Providing bottom door clearances ranging from 5/16 inch to 2-5/16 inches (7 to 59 mm).

C. Grade: Comply with BHMA A156.4, Grade 1.

D. Material: Base metal as indicated for each item by BHMA material and finish designation.

E. Types:

1. Standard-duty, with 2 inch (51 mm) shallow depth floor preparation, and having 260 lbs (118 kg) carrying weight.

F. Products:

1. BTS 75V Series.

2.5 BOLTS

A. Manufacturers:

1. Trimco: www.trimcohardware.com/#sle.

2. Rockwood.

3. Ives.

B. Properties:

1. Dustproof Strikes: For bolting into floor, provide except at metal thresholds.

C. Options:

1. Extension Bolts: In leading edge of door, one bolt into floor, one bolt into top of frame.

2.6 EXIT DEVICES

A. Manufacturers:

1. Precision Apex 2000 Series

2. Sargent 19GL80 Series.

3. Von Duprin XP98 Series

B. Properties:

1. Actuation: Crossbar.

2. Touchpads: 'T" style metal touchpads and rail assemblies with matching chassis covers end caps.

3. Latch Bolts: Stainless steel deadlocking with 3/4 inch (19 mm) projection using latch bolt.

4. Lever Design: Match project standard lockset trims.

5. Cylinder: Include where cylinder dogging or locking trim is indicated.

6. Strike as recommended by manufacturer for application indicated.

7. Dogging:

a. Non-Fire-Resistance-Rated Devices: Cylinder 1/4 inch (6 mm) hex key dogging.

b. Fire-Resistance-Rated Devices: Manual dogging not permitted.

8. Touch bar assembly on wide style exit devices to have a 1/4 inch (6.3 mm) clearance to allow for vision frames.

9. All exposed exit device components to be of architectural metals and “true” architectural finishes.

10. Handing: Field-reversible.

11. Fasteners on Back Side of Device Channel: Concealed - exposed fasteners not allowed.

12. Vertical Latch Assemblies' Operation: Gravity, without use of springs.

C. Grades: Complying with BHMA A156.3, Grade 1.

1. Provide exit devices tested and certified by UL or by a recognized independent laboratory for mechanical operational testing to 10 million cycles minimum with inspection confirming Grade 1 Loaded Forces have been maintained.

D. Standards Compliance:

1. UL Listed for Panic and Fire for Class II Circuitry.

2. Provide UL (DIR) listed exit device assemblies for fire-resistance-rated doors.

3. Comply with UL 10C.

E. Code Compliance: As required by authorities having jurisdiction in the State in which the Project is located.

1. Listed by UL as a Controlled Exit Device (FULA) and Special Locking Arrangements (FWAX) category.

F. Options:

1. Electrified Devices:

2. Delayed Egress Devices: Manufacturer's standard for the application.

3. Battery operated alarm function. Provide WH495 unit for Remote Arming/Disarming, as indicated in Door Hardware Schedule.

4. Remote powered alarm 12 VDC. Provide WH495 unit for Remote Arming/Disarming or External Activation.

5. Internally mounted switch used to signal other components.

6. Internally mounted switch that monitors the position of the latchbolt.

7. MLR: Motorized latch retraction.

8. Furnish less bottom rod (LBR) at scheduled locations to eliminate use of floor mounted strikes.

G. Products:

1. 2000.

2.7 ELECTRIC STRIKES

A. Manufacturers:

1. RCI; dormakaba Group: www.dormakaba.com/us-en/#sle.

2. HES.

3. Allegion.

B. Properties:

1. Provide UL 1034 compliant devices.

2. Provide UL 10C compliant devices.

3. Non-handed devices suitable for door frame material and scheduled lock configuration.

4. Include transformer and rectifier as necessary for complete installation.

5. Accommodating latch projections of 1/2 inch (13 mm) or 5/8 inch (16 mm).

C. Options: As applicable to each item specified.

1. Voltage: 12 VAC.

D. Installation: Connect electric strikes into fire alarm where non-rated doors are scheduled to release with fire or sprinkler alarm condition.

E. Products:

1. 2 Series (F2164, 2366).

2.8 LOCK CYLINDERS

A. Manufacturers:

1. BEST, dormakaba Group:

2. Substitutions: Not permitted.

B. Grades:

1. Standard Security Cylinders: Comply with BHMA A156.5.

C. Material:

1. Manufacturer's standard corrosion-resistant brass alloy.

D. Types: As applicable to each item specified.

1. Small format interchangeable core (SFIC) type cylinders, with seven pin cores.

E. Applications: At locations indicated in hardware sets, and as follows

1. As required for items with locking devices provided by other sections, including at elevator controls and cabinets.

a. When provisions for lock cylinders are referenced elsewhere in the Project Manual to this Section, provide compatible type of lock cylinder, keyed to building keying system, unless otherwise indicated.

2.9 MORTISE LOCKS

A. Manufacturers:

1. BEST, 40H Series dormakaba Group: www.bestaccess.com/#sle.

2. Schlage Lock Company L9000 Series.

3. Sargent 8200 Series

B. Properties:

1. Mechanical Locks: Manufacturer's standard.

a. Fitting modified ANSI A115.1 door preparation.

b. Door Thickness Coordination Fitting 1-3/4 inch (44 mm) to 2-1/4 inch (57 mm) thick doors.

c. Latch: Solid, one-piece, anti-friction, self-lubricating stainless steel.

1) Latchbolt Throw: 3/4 inch (19 mm), minimum.

d. Auxiliary Deadlatch: One piece stainless steel, permanently lubricated.

e. Backset: 2-3/4 inch (70 mm).

f. Lever Trim:

1) Functionality: Allow the lever handle to move up to 45 degrees from horizontal position prior to engaging the latchbolt assembly.

2) Strength: Locksets outside locked lever designed to withstand minimum 1,400 inch-lbs (158.2 Nm) of torque. In excess of that, a replaceable part will shear. Key from outside and/or inside lever will still operate lockset.

3) Spindle: Designed to prevent forced entry from attacking of lever.

4) Independent spring mechanism for each lever.

(a) Trim to be self-aligning and thru-bolted.

2. Electrified Locks: Same properties as standard locks, and as follows:

a. Function: Electrically locked (Fail Safe) or unlocked (Fail Secure), as indicated for each lock in Door Hardware Schedule.

C. Finishes: See Door Hardware Schedule.

1. Core Faces: Match finish of lockset.

D. Grades:

E. Products: Mortise locks, including standard and electrified types.

1. 40H.

2.10 DOOR PULLS AND PUSH PLATES

A. Manufacturers:

1. Trimco: www.trimcohardware.com/#sle.

2. Rockwood Manufacturing Company.

3. Ives Hardware.

B. Material: Stainless steel, unless otherwise indicated.

2.11 LADDER PULLS

A. Manufacturers:

1. Trimco: www.trimcohardware.com/#sle.

2. Rockwood Manufacturing Company.

3. Burns

B. Properties:

1. Proper number of support fixings to accommodate length of pull as recommended by the manufacturer. Mounting as specified in hardware set.

C. Installation:

1. Pull Handles Mounting Style: Use single-sided - SNG or back-to-back - B2B mounting methods, as appropriate for item specified and in coordination with door type and other hardware items.

D. Products:

1. AP430 Series.

2.12 CLOSERS

A. Manufacturers:

1. Dorma 8900 Series dormakaba Group: www.dormakaba.com/us-en/#sle.
2. Sargent 351 Series.
3. LCN 4040 Series
4. Dorma TS 93, Norton 2800 ST or equal.

B. Properties:

1. Surface Mounted Closers: Manufacturer's standard.
    a. Construction: R14 high silicon aluminum alloy.
    b. Mechanism: Separate tamper-resistant adjusting valves for closing and latching speeds.
    c. Hydraulic Fluid: All-weather type.
    d. Arm Assembly: Standard for product specified.
        1) Include hold-open, integral stop, or spring-loaded stop feature, as specified in Door Hardware Schedule.
        2) Parallel arm to be a heavy-duty rigid arm.
        3) Where “IS” or “S-IS” arms are specified in hardware sets, if manufacturer does not offer this arm provide a regular arm mount closer in conjunction with a heavy-duty overhead stop equal to a dormakaba 900 Series.
    e. Covers:
        1) Type: Standard for product selected.
            (a) Full.
        2) Material: Plastic.
        3) Finish: Painted.

C. Grades:

1. Closers: Comply with BHMA A156.4, Grade 1.
    a. Underwriters Laboratories Compliance:
        1) Product Listing: UL (DIR) and ULC for use on fire-resistance-rated doors.
            (a) UL 228 - Door Closers-Holders, With or Without Integral Smoke Detectors.

D. Code Compliance: As required by authorities having jurisdiction in the State in which the Project is located.

E. Types:

1. Rack-and-pinion, surface-mounted. 1-1/2 inches (38 mm) minimum bore.

2. Cam-and-roller, surface-mounted, adjustable spring power.

F. Installation:

1. Mounting: Includes surface mounted installations.

2. Mount closers on non-public side of door and stair side of stair doors unless otherwise noted in hardware sets.

3. At outswinging exterior doors, mount closer on interior side of door.

4. Provide adapter plates, shim spacers, and blade stop spacers as required by frame and door conditions.

5. Where an overlapping astragal is included on pairs of swinging doors, provide coordinator to ensure door leaves close in proper order.

G. Products:

1. Surface Mounted:

a. TS93.

b. 8900.

2.13 OVERHEAD STOPS AND HOLDERS

A. Manufacturers:

1. Architectural Builders Hardware Mfg (ABH): www.abhmfg.com/#sle.

2. Glynn Johnson.

3. Rixson

B. Sizes: Manufacturer’s standard for the application.

C. Finishes:

1. Arms and Brackets: Zinc-plated.

D. Grades: As applicable to item specified.

1. Comply with BHMA A156.8, Grade 1.

E. Material: Base metal as indicated for each item by BHMA material and finish designation.

1. Track Channel: Extruded aluminum alloy.

2. Slide Block: Machined from solid brass alloy.

F. Types:

1. Surface-applied.

2. Concealed.

G. Products:

1. Surface Overhead Stops and Holders:

a. ABH: 9020 Series.

2. Concealed Overhead Stops and Holders:

a. ABH: 1020 SL Series.

2.14 PROTECTION PLATES

A. Manufacturers:

1. Trimco: www.trimcohardware.com/#sle.

2. Rockwood Manufacturing Company.

3. Ives.

B. Properties:

1. Plates:

a. Kick Plates: Provide along bottom edge of push side of every wood door with closer, except aluminum storefront and glass entry doors, unless otherwise indicated.

1) Size: 10 inches (254 mm) high by 2 inch (51 mm) less door width (LDW) on push side of door.

b. Mop Plates: Provide along bottom edge of push side of doors to provide protection from cleaning liquids and equipment damage to door surface.

c. Edges: Beveled, on four (4) unless otherwise indicated.

C. Grades: Comply with BHMA A156.6.

D. Material: As indicated for each item by BHMA material and finish designation.

1. Metal Properties: Stainless steel.

a. Metal, Standard Duty: Thickness 0.050 inch (1.27 mm), minimum.

E. Installation:

1. Fasteners: Countersunk screw fasteners

2.15 STOPS AND HOLDERS

A. Manufacturers:

1. Trimco: www.trimcohardware.com/#sle.
2. Rockwood Manufacturing Company.
3. Ives.

B. General: Provide overhead stop/holder when wall or floor stop is not feasible.

C. Grades:

1. Door Holders, Wall Bumpers, and Floor Stops: Comply with BHMA A156.16 and Resilient Material Retention Test as described in this standard.

D. Types:

2.16 THRESHOLDS

A. Manufacturers:

1. National Guard Products, Inc: www.ngpinc.com/#sle.
2. Pemko.
3. Zero International.

B. Properties:

1. Threshold Surface: Fluted horizontal grooves across full width.

C. Grades: Thresholds: Comply with BHMA A156.21.

D. Material: Base metal as indicated for each item by BHMA material and finish designation.

E. Types: As applicable to project conditions. Provide barrier-free type at every location where specified.

1. Saddle Thresholds: Without thermal break.
2. Bumper Seal Thresholds with Gasket: Use silicone gaskets.

F. Products:

2.17 WEATHERSTRIPPING AND GASKETING

A. Manufacturers:

1. National Guard Products, Inc: www.ngpinc.com/#sle.
2. Pemko .
3. Zero International.

B. Properties:

1. Adhesive-Backed Perimeter Gasketing: Silicone gasket material applied to frame with self- adhesive.

C. Grades: Comply with BHMA A156.22.

D. Products:

1. Weatherstripping: See Door Hardware Schedule.

2. Smoke Seals: See Door Hardware Schedule.

3. Meeting Stile Seals: See Door Hardware Schedule.

4. Door Bottom Seals:

a. Door Sweeps: See Door Hardware Schedule.

2.18 ELECTRIFIED HARDWARE

A. Manufacturers:

1. Dormakaba

2. RCI

B. Properties:

1. Door Position Switches: Recessed devices with magnetic contacts.

2. Power Supply Units: Manufacturer's standard.

C. Products:

1. Power Supplies:

a. RPSMLR2.

2. Power Transfers:

a. EPT-5 BEST.

b. EPT-12C.

3. Wire Harnesses:

a. Precision wire harnesses.

4. Key Switches:

5. Push buttons.

2.19 KEYS AND CORES: KEY TO EXISTING MARYLAND DEPT. OF GENERAL SERVICES AS REQUIRED BY THE OWNER.

A. Manufacturers:

1. BEST, No Substitution dormakaba Group:

B. Properties: Complying with guidelines of BHMA A156.28.

1. Provide small format interchangeable core.

2. Provide keying information in compliance with DHI

3. Keying Schedule: Arrange for a keying meeting, with Architect, Owner and hardware supplier, and other involved parties to ensure locksets and locking hardware, are functionally correct and keying complies with project requirements.

4. Keying: Master keyed.

5. Include construction keying and control keying with Brass removable core cylinders.

6. Supply keys in following quantities:

a. Great Grand Master Keys: 2 each.

b. Grand Master Keys: 6 each.

c. Master Keys: 6 each each group.

d. Construction Master Keys: 15 each.

e. Construction Control Keys: 2 each.

f. Change Keys: 3 each change keys for each keyed core.

7. Deliver keys with identifying tags to Owner by security shipment direct from manufacturer.

8. Permanent Keys and Cores: Stamped with applicable key marking for identification. Do not include actual key cuts within visual key control marks or codes. Stamp permanent keys "Do Not Duplicate."

9. Include installation of permanent cores and return construction cores to hardware supplier. Construction cores and keys to remain property of hardware supplier.

2.20 KEY CABINETS

A. Manufacturers:

1. Lund Equipment Company, Inc: www.lundkey.com/#sle.

2. Telkee: www.telkee.com/#sle.

B. Properties:.

1. Key Management System: For each keyed lock on project, provide one set of consecutively numbered duplicate key tags with hanging hole and snap catch.

2. Security Key Tags: For each keyed lock on project, provide one set of matching key tags for permanent attachment to one key of each set.

3. Provide key collection envelopes, receipt cards, and index cards in quantity suitable to manage number of keys.

4. Mounting: Wall surface mounted.

5. Capacity: Actual quantity of keys, plus 50 percent additional capacity.

6. Key cabinet lock to facility's keying system.

C. Finishes: Baked enamel, manufacturer's standard color.

D. Material: Sheet steel.

E. Products:

1. Lund: .

2. Telkee:

2.21 FINISHES

A. Finishes: Identified in Hardware Sets.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that doors and frames are ready to receive this work; labeled, fire-rated doors and frames are properly installed, and dimensions are as indicated on shop drawings.

B. Correct all defects prior to proceeding with installation.

C. Verify that electric power is available to power operated devices and of correct characteristics.

3.2 INSTALLATION

A. Install hardware in accordance with manufacturer's instructions and applicable codes.

B. Install hardware using the manufacturer’s fasteners provided. Drill and tap all screw holes located in metallic materials. Do not use “Riv-Nuts” or similar products.

C. Install hardware on fire-rated doors and frames in accordance with applicable codes and NFPA 80.

D. Install hardware for smoke and draft control doors in accordance with NFPA 105.

E. Use templates provided by hardware item manufacturer.

F. Do not install surface mounted items until application of finishes to substrate are fully completed.

G. Wash down masonry walls and complete painting or staining of doors and frames.

H. Complete finish flooring prior to installation of thresholds.

I. Door Hardware Mounting Heights: Distance from finished floor to center line of hardware item. As indicated in following list; unless noted otherwise in Door Hardware Schedule or on drawings.

1. For Steel Doors and Frames: Install in compliance with DHI (LOCS) recommendations.

2. For Steel Doors and Frames: See Section 6549.

3. For Steel Door Frames: See Section 081213.

4. For Aluminum-Framed Storefront Doors and Frames: See Section 084313.

5. For Wood Doors: Install in compliance with DHI WDHS.3 recommendations.

6. Flush Wood Doors: See Section 081416.

7. Stile and Rail Wood Doors: See Section 081433.

8. Mounting heights in compliance with ADA Standards:

a. Locksets: 40-5/16 inch (1024 mm).

b. Push Plates/Pull Bars: 42 inch (1067 mm).

c. Deadlocks (Deadbolts): 48 inch (1219 mm).

d. Exit Devices: 40-5/16 inch (1024 mm).

e. Door Viewer: 43 inch (1092 mm); standard height 60 inch (1524 mm).

J. Set exterior door thresholds with full-width bead of elastomeric sealant at each point of contact with floor providing a continuous weather seal; anchor thresholds with stainless steel countersunk screws.

3.3 FIELD QUALITY CONTROL

A. Perform field inspection and testing under provisions of Section 014000 - Quality Requirements.

B. Provide an Architectural Hardware Consultant (AHC) to inspect installation and certify that hardware and installation has been furnished and installed in accordance with manufacturer's instructions and as specified.

3.4 CLEANING

A. Clean finished hardware in accordance with manufacturer's written instructions after final adjustments have been made.

B. Clean adjacent surfaces soiled by hardware installation activities.

3.5 PROTECTION

A. Protect finished Work under provisions of Section 017000 - Execution and Closeout Requirements.

B. Do not permit adjacent work to damage hardware or finish.

END OF SECTION

DOOR HARDWARE SETS ARE ON THE FOLLOWING PAGES

Manufacturer List

Code	Name
AB	ABH Manufacturing Inc.
BE	Best Access Systems
BY	By Related Section
DM	Dorma Door Controls
NA	National Guard
PR	BEST Precision Exit Devices
RC	RCI
SDCC	Security Door Controls
ST	BEST Hinges and Sliding
TR	Trimco
TRIM	Trimco

Option List

Code	Description
1/4-20 SSMS/EA	STAINLESS MACHINE SCREWS/EXPANSION ANC.
7/8"LTC	7/8" Lip-To-Center Strike
ALW	ALARM, REMOTE POWER
B4E-HEAVY-AP	BEVELED 4 EDGES - ARMOR PLATES
B4E-HEAVY-KP	BEVELED 4 EDGES - KICK PLATES
BF	BARRIER FREE OPENING FORCE
C	QUICK CONNECT WIRING OPTION
C	Quick Connect Wiring System
C181	CAM-ADAMS RITE MS CAM
CFC	CUT FOR CYLINDER
CSK	COUNTER SINKING OF KICK and MOP PLATES
CYLT	CUT FOR T-TURN
DE	DELAYED EGRESS
EPT Prep	EPT Prep (full mortise)
FL	Fire Exit Hardware
FS	Fail Safe
FSE	Fail Secure
G	Back-to-Back Mounted
LBR	LESS BOTTOM ROD
LD	Less Dogging
LS	LATCHBOLT MONITOR SWITCH
MCS	Mullion Cap Spacer (other Finishes)
MLR	MOTORIZED LATCH RETRACTION
N	Thru-Bolt w/ Flow-Thru
RQE	REQUEST TO EXIT
SEC. ST.	SECURITY STUD-STD & HEAVY WT. HINGES

Code	Description
SIA	ABRASIVE COATING-5" WIDTH-AL OR SS
TS	TOUCHBAR MONITORING SWITCH
UL Rated - Label	UL Rated - Label
VIB	Double Visual Indictor Option
VT	Vandal Trim (Other Finishes)

Finish List

Code	Description
26D	Satin Chrome
32D	Satin Stainless Steel
4	Satin Brass, Clear Enameled
606	Satin Brass, Clear Coated
626	Satin Chromium Plated
628	Satin Aluminum, Clear Anodized
630	Satin Stainless Steel
689	Aluminum Painted
696	Satin Brass Painted
AL	Aluminum
BLACK	Black
GREY	Grey
US32D	Stainless Steel, Dull
US4	Dull Brass

Hardware Sets

Set #001 - Ext Alum Ballistic Card Access Operator

Doors: 1001A

2	Continuous Hinge	Cont Hinge x CTW x CMG By Ballistic Door Manufacturer	628	BY
1	Key Remov Mullion	By Ballistic Door Manufacturer		BY
1	Cylinder	1E-74 / 12E PATD KRM as Req'd	626	BE
1	Exit Device	C MLR TS 2401 LD	630	PR
1	Exit Device	C MLR TS 2403 LD	630	PR
1	Rim Cylinder	12E-72 PATD	606	BE
2	Door Pull	AP433 72" N	630	TR
1	Auto Operator	See Section 08 71 13 - ED250 Dorma		BY
1	Push Button Actuator NOTE: Exterior mounted	910TC-HC Provided by Section 08 71 13	32D	RC
1	Closer	TS93 PT	689	DM
2	Overhead Stop	1020 SL Series	US32D	AB
1	Wiring Diagram	WIRING DIAGRAM FURNISHED BY HWDE. SUPPLIER		BY
1	Card Reader	CARD READER BY SECURITY VENDOR		BY
1	Power Supply	RPSMLR2BB		PR
1	Remote Release Aiphone	REMOTE RELEASE / AIPHONE BY SECURITY VENDOR		BY
2	Harness	WH-XXP (Length as REQ'D)		ST
2	Harness	WH-6E		ST
2	Harness	WH-192P		ST
1	Mortise Cylinder	1E-74 PATD	626	BE
1	Key Switch	801 AL L2	630	SDCC
2	Door Position Switch	9540	BLACK	RC
1	Gasketing	By Ballistic Door Manufacturer		BY
2	Door Sweep	By Ballistic Door Manufacturer		BY
1	Threshold	By Ballistic Door Manufacturer.		BY

Set #001 - Ext Alum Ballistic Card Access Operator

NOTE: Balance of weather-stripping by Ballistic Frame/Door manufacturer. Operation:
Open Hours:
PACS to schedule exit device latchbolts to be electrically retracted for manual push / pull operation. PACS to schedule exterior actuator to be enabled for automatic operation of RHR door leaf.

Closed Hours:
Doors closed and locked. Presentation of valid credential to reader @ RHR leaf will retract exit device latch bolt and enable actuator for either manual or automatic cycling of the RHR door leaf.

Egress always allowed through both door leaves. Mechanical key override. Key switch to turn operator on and off.
Coordinate wiring & final connections / installation with GC / EC / Security Vendor / Automatic Operator Supplier
Coordinate door hardware with ballistic door and frame manufacturer. Provide correct fasteners and all required brackets and plates required for proper installation of door hardware.
Door hardware supplier to confirm wire counts to ballistic door and frame manufacturer.
Door contact is part of continuous through wire hinge. Request to exit switch is integral to exit device.

Set #002 - Vest Alum Ballistic Card Access Operator

Doors: 1001B

Set #002 - Vest Alum Ballistic Card Access Operator

2	Continuous Hinge	Cont Hinge x CTW x CMG By Ballistic Door Manufacturer	628	BY
1	Key Remov Mullion	By Ballistic Door Manufacturer		BY
1	Cylinder	1E-74 / 12E PATD KRM as Req'd	626	BE
1	Exit Device	C MLR TS 2401 LD	630	PR
1	Exit Device	C MLR TS 2403 LD	630	PR
1	Rim Cylinder	12E-72 PATD	606	BE
2	Door Pull	AP433 72" N	630	TR
1	Auto Operator	See Section 08 71 13 - ED250 Dorma		BY
1	Push Button Actuator	910TC-HC Provided by Section 08 71 13	32D	RC
1	Closer	TS93 PT	689	DM
2	Overhead Stop	1020 SL Series	US32D	AB
1	Wiring Diagram	WIRING DIAGRAM FURNISHED BY HWDE. SUPPLIER		BY
1	Card Reader	CARD READER BY SECURITY VENDOR		BY
1	Power Supply	RPSMLR2BB		PR
1	Remote Release Aiphone	REMOTE RELEASE / AIPHONE BY SECURITY VENDOR		BY
2	Harness	WH-XXP (Length as REQ'D)		ST
2	Harness	WH-6E		ST
2	Harness	WH-192P		ST
2	Door Position Switch	9540	BLACK	RC
1	Key Switch	801 AL L2	630	SDCC
1	Mortise Cylinder	1E-74 PATD	626	BE

NOTE: Balance of weather-stripping by Ballistic Frame/Door manufacturer. Operation:
Open Hours:
PACS to schedule exit device latchbolts to be electrically retracted for manual push / pull operation. PACS to schedule Vestibule side actuator to be enabled for automatic operation of RHR door leaf.

Closed Hours:
Doors closed and locked. Presentation of valid credential to reader @ RHR leaf will retract exit device latch bolt and enable actuator for either manual or automatic cycling of the RHR door leaf.

Egress always allowed through both door leaves. Mechanical key override. Key switch to turn operator on and off.
Coordinate wiring & final connections / installation with GC / EC / Security Vendor / Automatic Operator Supplier
Coordinate door hardware with ballistic door and frame manufacturer. Provide correct fasteners and all required brackets and plates required for proper installation of door hardware.
Door hardware supplier to confirm wire counts to ballistic door and frame manufacturer.
Door contact is part of continuous through wire hinge. Request to exit switch is integral to exit device.

Set #003 - Ext Alum Ballistic - Operator Exit Only

Doors: 1001C

2	Continuous Hinge	Cont Hinge x CTW x CMG By Ballistic Door Manufacturer	628	BY
1	Key Remov Mullion	By Ballistic Door Manufacturer		BY
1	Cylinder	1E-74 / 12E PATD KRM as Req'd	626	BE
1	Exit Device	C MLR TS 2401 LD	630	PR
1	Exit Device	C TS 2401 LD	630	PR
1	Auto Operator	See Section 08 71 13 - ED250 Dorma		BY
1	Push Button Actuator	910TC-HC Provided by Section 08 71 13	32D	RC
1	Closer	TS93 PT	689	DM
2	Overhead Stop	1020 SL Series	US32D	AB
1	Wiring Diagram	WIRING DIAGRAM FURNISHED BY HWDE. SUPPLIER		BY
1	Power Supply	RPSMLR2BB		PR
2	Harness	WH-XXP (Length as REQ'D)		ST
2	Harness	WH-6E		ST
2	Harness	WH-192P		ST
1	Key Switch	801 AL L2	630	SDCC
1	Mortise Cylinder	1E-74 PATD	626	BE
2	Door Position Switch	9540	BLACK	RC
1	Gasketing	By Ballistic Door Manufacturer		BY
2	Door Sweep	By Ballistic Door Manufacturer		BY
1	Threshold	By Ballistic Door Manufacturer.		BY

NOTE: Balance of weather-stripping by Ballistic Frame/Door manufacturer. Operation: Vestibule side actuator signals retraction of exit device latch bolt of LHR leaf before cycling automatic operator.
Egress always allowed through both door leaves. Key switch to turn operator on and off.
Coordinate wiring & final connections / installation with GC / EC / Security Vendor / Automatic Operator Supplier
Coordinate door hardware with ballistic door and frame manufacturer. Provide correct fasteners and all required brackets and plates required for proper installation of door hardware.
Door hardware supplier to confirm wire counts to ballistic door and frame manufacturer.
Door contact is part of continuous through wire hinge. Request to exit switch is integral to exit device.

Set #004 - Vest Alum Ballistic - Operator Exit Only

Doors: 1001D

Set #004 - Vest Alum Ballistic - Operator Exit Only

2	Continuous Hinge	Cont Hinge x CTW x CMG By Ballistic Door Manufacturer	628	BY
1	Key Remov Mullion	By Ballistic Door Manufacturer		BY
1	Cylinder	1E-74 / 12E PATD KRM as Req'd	626	BE
1	Exit Device	C MLR TS 2401 LD	630	PR
1	Exit Device	C TS 2401 LD	630	PR
1	Auto Operator	See Section 08 71 13 - ED250 Dorma		BY
1	Push Button Actuator	910TC-HC Provided by Section 08 71 13	32D	RC
1	Closer	TS93 PT	689	DM
2	Overhead Stop	1020 SL Series	US32D	AB
1	Wiring Diagram	WIRING DIAGRAM FURNISHED BY HWDE. SUPPLIER		BY
1	Power Supply	RPSMLR2BB		PR
2	Harness	WH-XXP (Length as REQ'D)		ST
2	Harness	WH-6E		ST
2	Harness	WH-192P		ST
1	Key Switch	801 AL L2	630	SDCC
1	Mortise Cylinder	1E-74 PATD	626	BE
2	Door Position Switch	9540	BLACK	RC

NOTE: Balance of weather-stripping by Ballistic Frame/Door manufacturer. Operation:
Entry screening side actuator signals retraction of exit device latch bolt of LHR leaf before cycling automatic operator.
Egress always allowed through both door leaves. Key switch to turn operator on and off.
Coordinate wiring & final connections / installation with GC / EC / Security Vendor / Automatic Operator Supplier
Coordinate door hardware with ballistic door and frame manufacturer. Provide correct fasteners and all required brackets and plates required for proper installation of door hardware.
Door hardware supplier to confirm wire counts to ballistic door and frame manufacturer.
Door contact is part of continuous through wire hinge. Request to exit switch is integral to exit device.

Set #005 - Stair - Card Access

Doors: ST12

Set #005 - Stair - Card Access

1	Continuous Hinge	662HD UL EPT Prep	AL	ST
1	Exit Device	C MLR TS 2103 X 4903D LD	630	PR
1	Rim Cylinder	12E-72 PATD	626	BE
1	Closer	TS93 PT	689	DM
1	Kick Plate	K0050 10" x 2" LDW B4E-Heavy CSK	630	TR
1	Wall Bumper	1270CX	626	TR
1	Door Position Switch	9540	BLACK	RC
1	Power Transfer	EPT-12C		PR
1	Wiring Diagram	WIRING DIAGRAM FURNISHED BY HWDE. SUPPLIER		BY
1	Card Reader	CARD READER SUPPLIED UNDER DIVISION 28		BY
1	Power Supply	RPSMLR2BB		PR
1	Harness	WH-6E		ST
1	Harness	WH-192P		ST
1	Harness	WH-XXP (Length as REQ'D)		ST
1	Gasketing	2525 C @ Head & Jambs		NA

NOTE: Operation: Door normally closed and locked. Presentation of valid credential retracts exit device latchbolt allowing entry. Free egress at all times. Mechanical key by-pass. TS switch to act as Request to exit. Coordinate wiring / installation with GC / EC / Security Vendor.

Set #006 - Closet, Supply

Doors: 1002B, 1407

4	Butt Hinge	FBB179 4.5" x 4.5" NRP	4	ST
1	Storeroom Lockset	45H-7D14R PATD	626	BE
1	Overhead Stop	9020 Series	US32D	AB
3	Silencer	1229A	GREY	TR

Set #007 - Sec Office

Doors: 1002A

NOTE: All hardware by Millwork supplier.

Set #008 - Glass Swing Pair - Museum

Doors: 1200

1	Core	1CX-7 PATD	626	BE
1	Hardware by Door Mfg.	SEE SPECIFICATION SECTION		BY

NOTE: All Hardware by Glass Door Manufacture.

Set #009 - Closet

Doors: 1022

Set #009 - Closet

8	Butt Hinge	FBB179 4.5" x 4.5" NRP	4	ST
1	Manual Flushbolt	3917 Length as Req'd Top Bolt	606	TR
1	Storeroom Lockset	45H-7D14R PATD 7/8"LTC	606	BE
2	Overhead Stop	9020 Series	US4	AB
2	Silencer	1229A	GREY	TR

Set #010 - CSO Breakroom

Doors: 1024

4	Butt Hinge	FBB179 4.5" x 4.5"	26D	ST
1	Passage Set	45H-0N14R	626	BE
1	Closer	8916 SPA	689	DM
1	Kick Plate	K0050 10" x 2" LDW B4E-Heavy CSK	630	TR
1	Wall Bumper	1270CX	626	TR
1	Gasketing	2525 C @ Head & Jambs		NA

Set #011 - Spec Storage, Vault - Card Access

Doors: 1110, 1111, 1303

4	Butt Hinge	FBB179 4.5" x 4.5"	26D	ST
1	Elec Lockset	45HW-7DEU14R PATD C RQE	626	BE
1	Closer	8916 IS	689	DM
1	Kick Plate	K0050 10" x 2" LDW B4E-Heavy CSK	630	TR
1	Door Position Switch	9540	BLACK	RC
1	Power Transfer	EPT-12C		PR
1	Wiring Diagram	WIRING DIAGRAM FURNISHED BY HWDE. SUPPLIER		BY
1	Card Reader	CARD READER SUPPLIED UNDER DIVISION 28		BY
1	Harness	WH-6E		ST
1	Harness	WH-192P		ST
1	Harness	WH-XXP (Length as REQ'D)		ST
1	Power Supply	POWER SUPPLY SUPPLIED UNDER DIVISION 28		BY
3	Silencer	1229A	GREY	TR

NOTE: Door normally closed and locked. Presentation of valid credential releases secure lever allowing entry. Free egress at all times. Mechanical key by-pass. Lockset is Fail-Secure-Upon loss of power door remains secure. Coordinate wiring / installation with GC / EC / Security Vendor.

Set #012 - Spec Storage - Card Access

Doors: 1113

Set #012 - Spec Storage - Card Access

4	Butt Hinge	FBB179 4.5" x 4.5" NRP	4	ST
1	Elec Lockset	45HW-7DEU14R PATD C RQE	626	BE
1	Closer	8916 S-DS	689	DM
1	Kick Plate	K0050 10" x 2" LDW B4E-Heavy CSK	630	TR
1	Door Position Switch	9540	BLACK	RC
1	Power Transfer	EPT-12C		PR
1	Wiring Diagram	WIRING DIAGRAM FURNISHED BY HWDE. SUPPLIER		BY
1	Card Reader	CARD READER SUPPLIED UNDER DIVISION 28		BY
1	Harness	WH-6E		ST
1	Harness	WH-192P		ST
1	Harness	WH-XXP (Length as REQ'D)		ST
1	Power Supply	POWER SUPPLY SUPPLIED UNDER DIVISION 28		BY
3	Silencer	1229A	GREY	TR

NOTE: Door normally closed and locked. Presentation of valid credential releases secure lever allowing entry. Free egress at all times. Mechanical key by-pass. Lockset is Fail-Secure-Upon loss of power door remains secure. Coordinate wiring / installation with GC / EC / Security Vendor.

Set #013 - Recep Office

Doors: 1103

4	Butt Hinge	FBB179 4.5" x 4.5" NRP	26D	ST
1	Classroom Lockset	45H-7R14R PATD	626	BE
1	Overhead Stop	1020 SL Series	US32D	AB
3	Silencer	1229A	GREY	TR

Set #014 - Exterior Balcony - Ballistic Lev 4

Doors: 5105B, 5116B, 5126B, 5129B, 5145B, 5153B, 5164B, 5172B

1	Continuous Hinge	662HD UL EPT Prep	AL	ST
1	Dorm Lockset	45H-7T14R PATD RQE	630	BE
1	Closer	TS93 SPT	689	DM
1	Door Position Switch	9540	BLACK	RC
1	Harness	WH-XXP (Length as REQ'D)		ST
1	Harness	WH-6E		ST
1	Harness	WH-192P		ST
1	Power Transfer	EPT-12C		PR
1	Gasketing	700 EN @ Head & Jambs		NA
1	Door Sweep	By Ballistic Door Manufacturer		BY
1	Door Sweep	C699A		NA
1	Threshold	896 S 1/4-20 SSMS/EA SIA	AL	NA

NOTE: Coordinate door hardware with ballistic door and frame manufacturer. Provide correct fasteners and all required brackets and plates required for proper installation of door hardware. Coordinate wiring / installation with GC / EC / Security Vendor.

Set #015 - Office

Doors: 5200, B032, B033

4	Butt Hinge	FBB179 4.5" x 4.5"	26D	ST
1	Office Lockset	45H-7AT14R PATD	626	BE
1	Wall Bumper	1270CX	626	TR
3	Silencer	1229A	GREY	TR

Set #016 - Office, Judge Chamber

Doors: 1307, 1308, 1404, 1405, 1408, 1409, 1410, 1411, 1412, 2102, 2103, 2109, 2110, 2111, 2113, 2115, 2116, 2117, 2122, 2206, 2207, 2208, 2210, 2211, 2311, 2312, 2313, 2314, 2316, 2320, 2405, 2406, 2407, 3102, 3103, 3104, 3107, 3108, 3112, 3113, 3116, 3117, 3118, 3123, 3124, 3127, 3128, 3129, 3133, 3135, 3137, 3140, 3143, 3144, 3145, 3146, 3147, 3149, 3150, 3151, 3152, 3154, 3156, 3157, 3158, 3159, 3160, 3161, 3166, 3167, 3169, 3170, 3171, 3180, 3181, 3184, 3185, 3186, 3191, 3192, 3193, 3196, 3197, 3201, 3202, 3203, 3206, 3207, 3211, 3214, 3215, 3217, 3301, 3302, 3303, 3304, 4102, 4103, 4104, 4107, 4108, 4111, 4112, 4115, 4116, 4117, 4122, 4123, 4126, 4127, 4128, 4139, 4140, 4143, 4144, 4145, 4150, 4151, 4152, 4155, 4156, 4161, 4162, 4163, 4166, 4167, 5103, 5104, 5105A, 5108, 5109, 5113, 5116A, 5117, 5118, 5123, 5126A, 5127, 5128, 5141, 5142, 5145A, 5146, 5151, 5152, 5153A, 5156, 5161, 5162, 5163, 5164A, 5167, 5171, 5172A, 5176, 5301, 5302, 5303, 5306, 5307, 5308, 5400

4	Butt Hinge	FBB179 4.5" x 4.5"	26D	ST
1	Office Lockset	45H-7AT14R PATD	626	BE
1	Wall Bumper	1270CX	626	TR
1	Sound Seal	5020C @ Head & Jambs		NA

NOTE: Hinge 4 1/2 x 5 at door: 3116, 3127, 3193, 3203, 4115, 4126, 4152, 4163, 5116A, 5126A, 5153A, 5164A, 5172A

Set #017 - Office, Judge

Doors: 3162, 3165, 3176

4	Butt Hinge	FBB179 4.5" x 4.5"	26D	ST
1	Office Lockset	45H-7AT14R PATD	626	BE
1	Overhead Stop	1020 SL Series	US32D	AB
1	Sound Seal	5020C @ Head & Jambs		NA

Set #018 - Toilet Judges Chamber, Staff Toilet

Doors: 1023, 3106, 3115, 3126, 3134, 3177, 3182, 3195, 3205, 3213, 3216, 4106, 4114, 4125, 4141, 4154, 4165, 5106, 5115, 5125, 5135, 5144, 5155, 5166

4	Butt Hinge	FBB179 4.5" x 4.5"	26D	ST
1	Privacy Set	45H-0LT14R VIB	626	BE
1	Mop Plate	KM050 10" x 1" LDW B4E-Heavy CSK	630	TR
1	Wall Bumper	1270CX	626	TR
1	Gasketing	2525 C @ Head & Jambs		NA

Set #019 - Toilet Judges Chamber

Doors: 3138, 3139, 3212, 5173

Set #019 - Toilet Judges Chamber

4	Butt Hinge	FBB179 4.5" x 4.5"	26D	ST
1	Privacy Set	45H-0L14R	626	BE
1	Overhead Stop	1020 SL Series	US32D	AB
1	Mop Plate	KM050 10" x 1" LDW B4E-Heavy CSK	630	TR
1	Gasketing	2525 C @ Head & Jambs		NA

Set #020 - Staff Toilet, Lacation, Public Toilet

Doors: 1008, 1009, 1011, 1013, 1014, 2008, 2009, 2011, 2013, 2014, 2120, 2221, 3008, 3011, 3013, 3014, 3022, 3023, 4011, 4013, 4022, 4023, 4160, 5010, 5013, 5014, 5022, 5023, 5204, B008, B010, B011, B013

4	Butt Hinge	FBB179 4.5" x 4.5"	26D	ST
1	Privacy Set	45H-0LT14R VIB	626	BE
1	Closer	8916 AF89	689	DM
1	Kick Plate	K0050 10" x 2" LDW B4E-Heavy CSK	630	TR
1	Mop Plate	KM050 10" x 1" LDW B4E-Heavy CSK	630	TR
1	Wall Bumper	1270CX	626	TR
1	Gasketing	2525 C @ Head & Jambs		NA

Set #021 - Womens / Mens Room

Doors: 1020, 1021, 2020, 2021, 3020, 3021, 4020, 4021, 5020, 5021

1	Continuous Hinge	662HD UL	AL	ST
1	Classroom Deadlock	48H-7R PATD	626	BE
1	Pull Plate	1035-3 CFC	630	TR
1	Push Plate	1001-9 CYLT	630	TR
1	Closer	TS93 PT	689	DM
1	Kick Plate	K0050 10" x 2" LDW B4E-Heavy CSK	630	TR
1	Mop Plate	KM050 10" x 1" LDW B4E-Heavy CSK	630	TR
1	Wall Bumper	1270CX	626	TR
1	Gasketing	2525 C @ Head & Jambs		NA

Set #022 - Elec, Telecom, Conf - Card Access

Doors: 1005, 1006, 1017, 1104, 2005, 2006, 2017, 3005, 3006, 3017, 4005, 4006, 4017, 4134, 5005, 5017, 5129A, 5129C, 6003

Set #022 - Elec, Telecom, Conf - Card Access

4	Butt Hinge	FBB179 4.5" x 4.5" NRP	26D	ST
1	Elec Lockset	45HW-7DEU14R PATD C RQE	626	BE
1	Closer	8916 SPA	689	DM
1	Kick Plate	K0050 10" x 2" LDW B4E-Heavy CSK	630	TR
1	Wall Bumper	1270CX	626	TR
1	Door Position Switch	9540	BLACK	RC
1	Power Transfer	EPT-12C		PR
1	Wiring Diagram	WIRING DIAGRAM FURNISHED BY HWDE. SUPPLIER		BY
1	Card Reader	CARD READER SUPPLIED UNDER DIVISION 28		BY
1	Harness	WH-6E		ST
1	Harness	WH-192P		ST
1	Harness	WH-XXP (Length as REQ'D)		ST
1	Power Supply	POWER SUPPLY SUPPLIED UNDER DIVISION 28		BY
1	Gasketing	2525 C @ Head & Jambs		NA

NOTE: Operation: Door normally closed and locked. Presentation of valid credential releases secure lever allowing entry. Free egress at all times. Mechanical key by-pass. Lockset is Fail-Secure-Upon loss of power door remains secure. Coordinate wiring / installation with GC / EC / Security Vendor.

Set #023 - Stair - Card Access - Delay Egress

Doors: ST11B, ST13, ST14, ST22, ST23, ST24, ST32, ST33, ST34, ST42, ST43, ST44, ST52, ST53, ST54

1	Continuous Hinge	662HD UL EPT Prep	AL	ST
1	Exit Device	DE FL E2103 X 4908D FS	630	PR
1	Rim Cylinder	12E-72 PATD	626	BE
1	Mortise Cylinder	1E-74 PATD	626	BE
1	Closer	TS93 T	689	DM
1	Kick Plate	K0050 10" x 2" LDW B4E-Heavy CSK	630	TR
1	Wall Bumper	1270CX	626	TR
1	Door Position Switch	9540	BLACK	RC
1	Wiring Diagram	WIRING DIAGRAM FURNISHED BY HWDE. SUPPLIER		BY
2	Card Reader	CARD READER SUPPLIED UNDER DIVISION 28		BY
1	Power Supply - DE Device	PS161-6		PR
1	Power Transfer	EPT-5		PR
1	Gasketing	2525C @ Head & Jambs		NA

Set #023 - Stair - Card Access - Delay Egress

NOTE: Operation: Door is normally closed and locked. Presenting valid credential at outside card reader releases secure lever allowing entry. Key override will bypass card reader and permit ingress.
Presenting valid credential on egress side of door will shunt alarm and delay process allowing immediate egress.
Delayed Egress: Depressing exit device touchpad for longer than nuisance period starts a 15 second alarmed delay. After 15 seconds, exit device releases allowing egress. Once alarm has been initiated reset is done by mechanical key at the exit device.
Upon loss of power event or building fire alarm system activation electrified trim of exit device to unlock allowing entry.
Wiring from Power Supply to Exit Device by EC.
Coordinate with electrical, fire alarm, and security.

Set #024 - Xerox, Supplies, Storage, Pantry Prep

Doors: 1309, 1310, 2105, 2106A, 3190, 3218, 4132, 4133, 5136, 5305

4	Butt Hinge	FBB179 4.5" x 4.5"	26D	ST
1	Classroom Lockset	45H-7R14R PATD	626	BE
1	Wall Bumper	1270CX	626	TR
3	Silencer	1229A	GREY	TR

Set #025 - Break Room, Collaboration

Doors: 1304, 1406, 3119, 3175, B038

4	Butt Hinge	FBB179 4.5" x 4.5"	26D	ST
1	Passage Set	45H-0N14R	626	BE
1	Closer	8916 AF89	689	DM
1	Kick Plate	K0050 10" x 2" LDW B4E-Heavy CSK	630	TR
1	Wall Bumper	1270CX	626	TR
1	Sound Seal	5020C @ Head & Jambs		NA

Set #026 - Phone, Wellness, Workroom, Breakroom

Doors: 2112, 2121, 2201, 2202, 2203, 2204, 2213A, 2214A, 2215, 3173, 3174, 5102, 5112, 5122, 5147, 5157, 5168, 5175, B031

4	Butt Hinge	FBB179 4.5" x 4.5"	26D	ST
1	Passage Set	45H-0N14R	626	BE
1	Wall Bumper	1270CX	626	TR
1	Sound Seal	5020C @ Head & Jambs		NA

Set #027 - Telecom Room

Doors: 1016, 3016, 5016

Set #027 - Telecom Room

8	Butt Hinge	FBB168 5" X 4.5" NRP	26D	ST
1	Semi-Auto Flushbolt	3820 X 3810	626	TR
1	Electromechanical Lock	45HW-7DEU14R PATD 7/8"LTC C RQE	626	BE
1	Drop Arm Coordinator	3092	BLACK	TR
1	Closer	8916 SPA	689	DM
1	Closer	8916 S-DS	689	DM
2	Kick Plate	K0050 10" x 1" LDW B4E-Heavy CSK	630	TR
1	Wall Bumper	1270CX	626	TR
1	Wiring Diagram	WIRING DIAGRAM FURNISHED BY HWDE. SUPPLIER		BY
1	Card Reader	CARD READER SUPPLIED UNDER DIVISION 28		BY
1	Harness	WH-6E		ST
1	Harness	WH-192P		ST
1	Harness	WH-XXP (Length as REQ'D)		ST
1	Power Supply	POWER SUPPLY SUPPLIED UNDER DIVISION 28		BY
1	Dust Proof Strike	3910	626	TR
1	Gasketing	2525 C @ Head & Jambs		NA
1	Meeting Stile Seal	5070 CL		NA

NOTE: Doors normally closed and locked. Presentation of valid credential releases secure lever allowing entry. Free egress at all times. Mechanical key by-pass. Lockset is Fail-Secure-Upon loss of power door remains secure. Coordinate wiring / installation with GC / EC / Security Vendor.

Set #028 - Telecom Room

Doors: 2016, 4016

8	Butt Hinge	FBB168 5" X 4.5" NRP	26D	ST
1	Semi-Auto Flushbolt	3820 X 3810	626	TR
1	Electromechanical Lock	45HW-7DEU14R PATD 7/8"LTC C RQE	626	BE
1	Drop Arm Coordinator	3092	BLACK	TR
2	Closer	8916 S-DS	689	DM
2	Kick Plate	K0050 10" x 1" LDW B4E-Heavy CSK	630	TR
1	Wiring Diagram	WIRING DIAGRAM FURNISHED BY HWDE. SUPPLIER		BY
1	Card Reader	CARD READER SUPPLIED UNDER DIVISION 28		BY
1	Harness	WH-6E		ST
1	Harness	WH-192P		ST
1	Harness	WH-XXP (Length as REQ'D)		ST
1	Power Supply	POWER SUPPLY SUPPLIED UNDER DIVISION 28		BY
1	Dust Proof Strike	3910	626	TR
1	Gasketing	2525 C @ Head & Jambs		NA
1	Meeting Stile Seal	5070 CL		NA

NOTE: Doors normally closed and locked. Presentation of valid credential releases secure lever allowing entry. Free egress at all times. Mechanical key by-pass. Lockset is Fail-Secure-Upon loss of power door remains secure. Coordinate wiring / installation with GC / EC / Security Vendor.

Set #029 - Service Vestibule - Mag Holders

Doors: 1012, 2012, 3012, 4012, 5012

8	Butt Hinge	FBB179 4.5" x 4.5"	26D	ST
1	Exit Device	FL 2801 LBR	630	PR
1	Exit Device	FL 2814 X 4914D LBR	630	PR
2	Magnetic Holder	EM 504-24120	689	DM
2	Closer	8916 AF89	689	DM
2	Armor Plate	KA050 30" x 1" LDW B4E-Heavy CSK UL Label	630	TR
1	Meeting Stile Seal	5070 CL		NA
1	Gasketing	2525C @ Head & Jambs		NA

NOTE: Verify Door width (ADA). Operation: Doors normally closed. Doors may be held open by wall magnetic holders. In the event of loss of power or activation of fire alarm, doors release to close and latch. Magnetic holders tied into fire alarm system. Coordinate wiring / installation with GC / EC / Security Vendor.

Set #030 - Chamber Closet

Doors: 5174

4	Butt Hinge	FBB179 4.5" x 4.5"	26D	ST
1	Passage Set	45H-0N14R	626	BE
1	Overhead Stop	9020 Series	US32D	AB
3	Silencer	1229A	GREY	TR

NOTE: Operation: Doors normally held open by wall magnetic holders. In the event of loss of power or activation of fire alarm, doors release to close and latch. Magnetic holders tied into fire alarm system. Coordinate wiring / installation with GC / EC / Security Vendor.

Set #031 - Judges Closet

Doors: 3105, 3114, 3125, 3183, 3194, 3204, 4105, 4113, 4124, 4142, 4153, 4164, 5107, 5114, 5124, 5143, 5154, 5165

8	Butt Hinge	FBB179 4.5" x 4.5" NRP	26D	ST
2	Single Dummy	45H-01DT14R	626	BE
2	Overhead Stop	9020 Series	US32D	AB
2	Roller Latch	1559WB	626	TR
2	Silencer	1229A	GREY	TR

Set #032 - Chamber Circulation - Card Access/Remote

Doors: 3101, 3111, 3122, 3179, 3189, 3200, 4110, 4121, 4138, 4148, 4159, 5111

Set #032 - Chamber Circulation - Card Access/Remote

4	Butt Hinge	FBB179 4.5" x 4.5" NRP	26D	ST
1	Elec Lockset	45HW-7DEU14R PATD C RQE	626	BE
1	Closer	8916 SPA	689	DM
1	Kick Plate	K0050 10" x 2" LDW B4E-Heavy CSK	630	TR
1	Wall Bumper	1270CX	626	TR
1	Door Position Switch	9540	BLACK	RC
1	Power Transfer	EPT-12C		PR
1	Wiring Diagram	WIRING DIAGRAM FURNISHED BY HWDE. SUPPLIER		BY
1	Card Reader	CARD READER SUPPLIED UNDER DIVISION 28		BY
1	Harness	WH-6E		ST
1	Harness	WH-192P		ST
1	Harness	WH-XXP (Length as REQ'D)		ST
1	Remote Release	REMOTE RELEASE SUPPLIED UNDER DIVISION 28		BY
1	Power Supply	POWER SUPPLY SUPPLIED UNDER DIVISION 28		BY
1	Gasketing	2525 C @ Head & Jambs		NA

NOTE: Hinge 4 1/2 x 5 at door: 3101, 3179, 4138, 5111. Operation: Door normally closed and locked. Presentation of valid credential or Remote release releases secure lever allowing entry. Free egress at all times. Mechanical key by-pass. Lockset is Fail-Secure-Upon loss of power door remains secure. Coordinate wiring / installation with GC / EC / Security Vendor.

Set #033 - Chamber Circulation - Card Access/Remote

Doors: 4101, 5101, 5121, 5140, 5150, 5160, 5170, 5300

4	Butt Hinge	FBB179 4.5" x 4.5" NRP	26D	ST
1	Elec Lockset	45HW-7DEU14R PATD C RQE	626	BE
1	Closer	8916 S-DS	689	DM
1	Kick Plate	K0050 10" x 2" LDW B4E-Heavy CSK	630	TR
1	Door Position Switch	9540	BLACK	RC
1	Power Transfer	EPT-12C		PR
1	Wiring Diagram	WIRING DIAGRAM FURNISHED BY HWDE. SUPPLIER		BY
1	Card Reader	CARD READER SUPPLIED UNDER DIVISION 28		BY
1	Harness	WH-6E		ST
1	Harness	WH-192P		ST
1	Harness	WH-XXP (Length as REQ'D)		ST
1	Remote Release	REMOTE RELEASE SUPPLIED UNDER DIVISION 28		BY
1	Power Supply	POWER SUPPLY SUPPLIED UNDER DIVISION 28		BY
1	Gasketing	2525 C @ Head & Jambs		NA

NOTE: Operation: Door normally closed and locked. Presentation of valid credential or Remote release releases secure lever allowing entry. Free egress at all times. Mechanical key by-pass. Lockset is Fail-Secure-Upon loss of power door remains secure. Coordinate wiring / installation with GC / EC / Security Vendor.

Set #034 - Closet

Doors: 2305B, 2306B, 5169

8	Butt Hinge	FBB179 4.5" x 4.5" NRP	26D	ST
1	Manual Flushbolt	3917- Length as Req'd - Top Bolt	626	TR
1	Storeroom Lockset	45H-7D14R PATD 7/8"LTC	626	BE
2	Overhead Stop	9020 Series	US32D	AB
2	Silencer	1229A	GREY	TR

Set #035 - Janitor - Card Access

Doors: 1019, 2019, 3019, 4019, 5019

4	Butt Hinge	FBB179 4.5" x 4.5" NRP	26D	ST
1	Elec Lockset	45HW-7DEU14R PATD C RQE	626	BE
1	Closer	8916 SPA	689	DM
1	Kick Plate	K0050 10" x 2" LDW B4E-Heavy CSK	630	TR
1	Wall Bumper	1270CX	626	TR
1	Door Position Switch	9540	BLACK	RC
1	Power Transfer	EPT-12C		PR
1	Wiring Diagram	WIRING DIAGRAM FURNISHED BY HWDE. SUPPLIER		BY
1	Card Reader	CARD READER SUPPLIED UNDER DIVISION 28		BY
1	Harness	WH-6E		ST
1	Harness	WH-192P		ST
1	Harness	WH-XXP (Length as REQ'D)		ST
1	Power Supply	POWER SUPPLY SUPPLIED UNDER DIVISION 28		BY
1	Mop Plate	KM050 10" x 1" LDW B4E-Heavy CSK	630	TR
3	Silencer	1229A	GREY	TR

NOTE: Door normally closed and locked. Presentation of valid credential releases secure lever allowing entry. Free egress at all times. Mechanical key by-pass. Lockset is Fail-Secure-Upon loss of power door remains secure. Coordinate wiring / installation with GC / EC / Security Vendor.

Set #036 - Janitor, Elec, Library - Card Access

Doors: 1311, 1402, 1416, 4118, 4149, 5027, 5137, 5138, B034, B046, B049

Set #036 - Janitor, Elec, Library - Card Access

4	Butt Hinge	FBB179 4.5" x 4.5"	26D	ST
1	Elec Lockset	45HW-7DEU14R PATD C RQE	626	BE
1	Closer	8916 AF89	689	DM
1	Kick Plate	K0050 10" x 2" LDW B4E-Heavy CSK	630	TR
1	Wall Bumper	1270CX	626	TR
1	Door Position Switch	9540	BLACK	RC
1	Power Transfer	EPT-12C		PR
1	Wiring Diagram	WIRING DIAGRAM FURNISHED BY HWDE. SUPPLIER		BY
1	Card Reader	CARD READER SUPPLIED UNDER DIVISION 28		BY
1	Harness	WH-6E		ST
1	Harness	WH-192P		ST
1	Harness	WH-XXP (Length as REQ'D)		ST
1	Power Supply	POWER SUPPLY SUPPLIED UNDER DIVISION 28		BY
3	Silencer	1229A	GREY	TR

NOTE: Operation: Door normally closed and locked. Presentation of valid credential releases secure lever allowing entry. Free egress at all times. Mechanical key by-pass. Lockset is Fail-Secure-Upon loss of power door remains secure. Coordinate wiring / installation with GC / EC / Security Vendor.

Set #036A - Security Office - Card Access

Doors: 1028

4	Butt Hinge	FBB179 4.5" x 4.5"	4	ST
1	Electromechanical Lock	45HW-7DEU14R PATD C RQE	606	BE
1	Closer	8916 AF89	606	DM
1	Kick Plate	K0050 10" x 2" LDW B4E-Heavy CSK	606	TR
1	Wall Bumper	1270CX	606	TR
1	Door Position Switch	9540	BLACK	RC
1	Power Transfer	EPT-12C		PR
1	Wiring Diagram	WIRING DIAGRAM FURNISHED BY HWDE. SUPPLIER		BY
1	Card Reader	CARD READER SUPPLIED UNDER DIVISION 28		BY
1	Harness	WH-6E		ST
1	Harness	WH-192P		ST
1	Harness	WH-XXP (Length as REQ'D)		ST
1	Power Supply	POWER SUPPLY SUPPLIED UNDER DIVISION 28		BY
1	Wiring Harness	WH495		PR
3	Silencer	1229A	GREY	TR

NOTE: Operation: Door normally closed and locked. Presentation of valid credential releases secure lever allowing entry. Free egress at all times. Mechanical key by-pass. Lockset is Fail-Secure-Upon loss of power door remains secure. Coordinate wiring / installation with GC / EC / Security Vendor.

Set #037 - Chamber Circulation - Card Access/Remote

Doors: 4169

4	Butt Hinge	FBB179 4.5" x 4.5" NRP SEC. ST.	26D	ST
1	Electromechanical Lock	45HW-7DEU14R PATD C RQE VT	626	BE
1	Closer	8916 SPA	689	DM
1	Kick Plate	K0050 10" x 2" LDW B4E-Heavy CSK	630	TR
1	Wall Bumper	1270CX	626	TR
1	Door Position Switch	9540	BLACK	RC
1	Power Transfer	EPT-12C		PR
1	Wiring Diagram	WIRING DIAGRAM FURNISHED BY HWDE. SUPPLIER		BY
1	Card Reader	CARD READER SUPPLIED UNDER DIVISION 28		BY
1	Harness	WH-6E		ST
1	Harness	WH-192P		ST
1	Harness	WH-XXP (Length as REQ'D)		ST
1	Remote Release	REMOTE RELEASE SUPPLIED UNDER DIVISION 28		BY
1	Power Supply	POWER SUPPLY SUPPLIED UNDER DIVISION 28		BY
1	Gasketing	2525 C @ Head & Jambs		NA

NOTE: Coordinate Door Hardware with Ballistic Frame/Door manufacturer. Operation: Door normally closed and locked. Presentation of valid credential or Remote release releases secure lever allowing entry. Free egress at all times. Mechanical key by-pass. Lockset is Fail-Secure- Upon loss of power door remains secure. Coordinate wiring / installation with GC / EC / Security Vendor.

Set #038 - Judge's Conf, Pantry Prep

Doors: 1401, 4170, 4172A, 4172B, 5205

4	Butt Hinge	FBB179 4.5" x 4.5"	26D	ST
1	Passage Set	45H-0N14R	626	BE
1	Wall Bumper	1270CX	626	TR
3	Silencer	1229A	GREY	TR

Set #038A - Robing Storage

Doors: 4171

4	Butt Hinge	FBB179 4.5" x 4.5"	26D	ST
1	Storeroom Lockset	45H-7D14R PATD	626	BE
1	Closer	8916 IS	689	DM
1	Kick Plate	K0050 10" x 1" LDW B4E-Heavy CSK	606	TR
3	Silencer	1229A	GREY	TR

Set #039 - Judge's Conf, Mediation - Card Access

Doors: 2213B, 2214B, 4135, 5133A, 5133B

Set #039 - Judge's Conf, Mediation - Card Access

4	Butt Hinge	FBB179 4.5" x 4.5"	26D	ST
1	Elec Lockset	45HW-7DEU14R PATD C RQE	626	BE
1	Closer	8916 AF89	689	DM
1	Kick Plate	K0050 10" x 2" LDW B4E-Heavy CSK	630	TR
1	Wall Bumper	1270CX	626	TR
1	Door Position Switch	9540	BLACK	RC
1	Power Transfer	EPT-12C		PR
1	Wiring Diagram	WIRING DIAGRAM FURNISHED BY HWDE. SUPPLIER		BY
1	Card Reader	CARD READER SUPPLIED UNDER DIVISION 28		BY
1	Harness	WH-6E		ST
1	Harness	WH-192P		ST
1	Harness	WH-XXP (Length as REQ'D)		ST
1	Power Supply	POWER SUPPLY SUPPLIED UNDER DIVISION 28		BY
1	Sound Seal	5020C @ Head & Jambs		NA

NOTE: Hinge 4 1/2 x 5 at door: 5133A. Operation: Door normally closed and locked. Presentation of valid credential releases secure lever allowing entry. Free egress at all times. Mechanical key by-pass. Lockset is Fail-Secure-Upon loss of power door remains secure. Coordinate wiring / installation with GC / EC / Security Vendor.

Set #040 - Judge's Conference - Card Access

Doors: 5202C

4	Butt Hinge	FBB168 5" X 4.5" NRP	26D	ST
1	Elec Lockset	45HW-7DEU14R PATD C RQE	626	BE
1	Closer	8916 S-DS	689	DM
1	Kick Plate	K0050 10" x 2" LDW B4E-Heavy CSK	630	TR
1	Door Position Switch	9540	BLACK	RC
1	Power Transfer	EPT-12C		PR
1	Wiring Diagram	WIRING DIAGRAM FURNISHED BY HWDE. SUPPLIER		BY
1	Card Reader	CARD READER SUPPLIED UNDER DIVISION 28		BY
1	Harness	WH-6E		ST
1	Harness	WH-192P		ST
1	Harness	WH-XXP (Length as REQ'D)		ST
1	Power Supply	POWER SUPPLY SUPPLIED UNDER DIVISION 28		BY
1	Sound Seal	5020C @ Head & Jambs		NA

NOTE: Verify hardware with relocated doors. Patch, Prep and modify existing door as required by GC. Fill or patch all remaining holes or preps. Operation: Door normally closed and locked. Presentation of valid credential releases secure lever allowing entry. Free egress at all times. Mechanical key by-pass. Lockset is Fail-Secure-Upon loss of power door remains secure. Coordinate wiring / installation with GC / EC / Security Vendor.

Set #041 - Courtroom - Card Access

Doors: 5202D

Set #041 - Courtroom - Card Access

4	Butt Hinge	FBB168 5" X 4.5" NRP	26D	ST
1	Elec Lockst Fail Safe	45HW-7WEL14R PATD C	626	BE
1	Closer	8916 S-DS	689	DM
1	Kick Plate	K0050 10" x 2" LDW B4E-Heavy CSK	630	TR
1	Door Position Switch	9540	BLACK	RC
1	Power Transfer	EPT-12C		PR
1	Wiring Diagram	WIRING DIAGRAM FURNISHED BY HWDE. SUPPLIER		BY
2	Card Reader	CARD READER SUPPLIED UNDER DIVISION 28		BY
1	Harness	WH-6E		ST
1	Harness	WH-192P		ST
1	Harness	WH-XXP (Length as REQ'D)		ST
1	Power Supply	POWER SUPPLY SUPPLIED UNDER DIVISION 28		BY
1	Sound Seal	5020C @ Head & Jambs		NA

NOTE: Verify hardware with relocated doors. Patch, Prep and modify existing door as required by GC. Fill or patch all remaining holes or preps. Door normally closed and locked. Presentation of valid credential from either side releases secure lever allowing entry. Mechanical key by-pass. Lockset is Fail-Safe-Upon loss of levers will release. Coordinate wiring / installation with GC / EC / Security Vendor.

Set #042 - Public Meeting

Doors: 5202B

4	Butt Hinge	FBB168 5" X 4.5" NRP	26D	ST
1	Classroom Lockset	45H-7R14R PATD	626	BE
1	Closer	8916 S-DS	689	DM
1	Kick Plate	K0050 10" x 2" LDW B4E-Heavy CSK	630	TR
1	Sound Seal	5020C @ Head & Jambs		NA

NOTE: Verify hardware with relocated doors. Patch, Prep and modify existing door as required by GC. Fill or patch all remaining holes or preps.

Set #043 - Courtroom

Doors: 5202A

NOTE: All Existing Hardware to be Refinished and Reused.

Set #044 - Public Meeting - Card Access

Doors: 5201

Set #044 - Public Meeting - Card Access

4	Butt Hinge	FBB179 4.5" x 4.5"	26D	ST
1	Elec Lockset	45HW-7DEU14R PATD C RQE	626	BE
1	Closer	8916 IS	689	DM
1	Kick Plate	K0050 10" x 2" LDW B4E-Heavy CSK	630	TR
1	Door Position Switch	9540	BLACK	RC
1	Power Transfer	EPT-12C		PR
1	Wiring Diagram	WIRING DIAGRAM FURNISHED BY HWDE. SUPPLIER		BY
1	Card Reader	CARD READER SUPPLIED UNDER DIVISION 28		BY
1	Harness	WH-6E		ST
1	Harness	WH-192P		ST
1	Harness	WH-XXP (Length as REQ'D)		ST
1	Power Supply	POWER SUPPLY SUPPLIED UNDER DIVISION 28		BY
1	Sound Seal	5020C @ Head & Jambs		NA

NOTE: Door normally closed and locked. Presentation of valid credential releases secure lever allowing entry. Free egress at all times. Mechanical key by-pass. Lockset is Fail-Secure-Upon loss of power door remains secure. Coordinate wiring / installation with GC / EC / Security Vendor.

Set #045 - Public Circulation

Doors: 5008

6	Butt Hinge	FBB179 4.5" x 4.5" NRP	26D	ST
1	Manual Flushbolt	3917- Length as Req'd - Top Bolt	626	TR
1	Classroom Lockset	45H-7R14R PATD 7/8"LTC	626	BE
1	Closer	8916 S-DS	689	DM
1	Overhead Stop	1020 SL Series	US32D	AB
2	Kick Plate	K0050 10" x 1" LDW B4E-Heavy CSK	630	TR
1	Sound Seal	5020C @ Head & Jambs		NA
1	Meeting Stile Seal	5070 CL		NA

Set #046 - Courtroom Vest - Card Access

Doors: 4211A, 4214

4	Pivot	75233	606	DM
2	Floor Closer	BTS 75V/F BF	606	DM
2	Terrazo Pan	TP75V		DM
1	Exit Device	C MLR TS 2801 LBR	606	PR
1	Exit Device	C MLR TS 2803 LBR	606	PR
1	Rim Cylinder	12E-72 PATD	606	BE
2	Door Pull	AP433 72" N	606	TR
2	Overhead Stop	S1020 SL Series	US4	AB

Set #046 - Courtroom Vest - Card Access

NOTE: See special template

2	Door Position Switch	9540	BLACK	RC
2	Power Transfer	EPT-12C		PR
1	Wiring Diagram	WIRING DIAGRAM FURNISHED BY HWDE. SUPPLIER		BY
1	Card Reader	CARD READER SUPPLIED UNDER DIVISION 28		BY
1	Power Supply	RPSMLR2BB		PR
2	Harness	WH-6E		ST
2	Harness	WH-192P		ST
2	Harness	WH-XXP (Length as REQ'D)		ST
1	Sound Seal	5020C @ Head & Jambs		NA
1	Meeting Stile Seal	5070 CL		NA
2	Wall Bumper	1270CX	606	TR

NOTE: Door Weight Not To Exceed 260 Pounds. Coordinate hardware with Frame/Door manufacturer. Verify template with ABH. Access control system to schedule exit device latchbolts to be retracted for manual push / pull operation. Closed Hours: Doors closed and locked. Presentation of valid credential to card reader will retract active leaf latchbolt allowing authorized entry. Egress always allowed through both door leaves. TS switch to act as Request to exit. Mechanical key override. All wiring and conduit by electrical contractor. Coordinate wiring and installation with EC / GC / Security Vendor.

Set #047 - Courtroom

Doors: 4201A, 4210A, 4215

8	Butt Hinge	FBB168 4.5" x 4.5"	4	ST
2	Offset Pulls B to B Mtg	AP433 72" G	606	TR
2	Closer	8916 S-DS	606	DM
2	Kick Plate	K0050 10" x 1" LDW B4E-Heavy CSK	606	TR
1	Sound Seal	5020C @ Head & Jambs		NA
1	Meeting Stile Seal	5070 CL		NA

Set #048 - Courtroom Vest - Card Access - SS Fr/Dr

Doors: 4200A, 5000

4	Pivot	75233	606	DM
2	Floor Closer	BTS 75V/F BF	606	DM
2	Terrazo Pan	TP75V		DM
1	Exit Device	C FL MLR TS 2801 LBR	606	PR
1	Exit Device	C FL MLR TS 2803 LBR	606	PR
1	Rim Cylinder	12E-72 PATD	606	BE
2	Door Pull	AP433 72" N	606	TR
2	Overhead Stop	S1020 SL Series	US4	AB

Set #048 - Courtroom Vest - Card Access - SS Fr/Dr

NOTE: See special template

2	Door Position Switch	9540	BLACK	RC
2	Power Transfer	EPT-12C		PR
1	Wiring Diagram	WIRING DIAGRAM FURNISHED BY HWDE. SUPPLIER		BY
1	Card Reader	CARD READER SUPPLIED UNDER DIVISION 28		BY
1	Power Supply	RPSMLR2BB		PR
2	Harness	WH-6E		ST
2	Harness	WH-192P		ST
2	Harness	WH-XXP (Length as REQ'D)		ST
1	Sound Seal	5020C @ Head & Jambs		NA
1	Meeting Stile Seal	5070 CL		NA

NOTE: Door Weight Not To Exceed 260 Pounds. Coordinate hardware with Frame/Door manufacturer. Verify template with ABH. Access control system to schedule exit device latchbolts to be retracted for manual push / pull operation. Closed Hours: Doors closed and locked. Presentation of valid credential to card reader will retract active leaf latchbolt allowing authorized entry. Egress always allowed through both door leaves. TS switch to act as Request to exit. Mechanical key override. All wiring and conduit by electrical contractor. Coordinate wiring and installation with EC / GC / Security Vendor.

Set #049 - Public Circulation, Stair - Mag Hold

Doors: 1007, 1018A, 2007, 2018, 4007, 4018, 5007, 5018, ST11A, ST21, ST31, ST41, ST51, 3007

4	Pivot	75233	606	DM
2	Floor Closer	BTS 75V/F BF	606	DM
2	Terrazo Pan	TP75V		DM
1	Fire Exit Device	FL 2801 LBR	606	PR
1	Exit Device	FL 2814 X 4914D LBR	606	PR
2	Magnetic Holder	EM 504-24120	696	DM
1	Power Supply	RPSMLR2BB		PR
1	Meeting Stile Seal	5070 CL		NA
1	Gasketing	2525C @ Head & Jambs		NA

NOTE: Door Weight Not To Exceed 260 Pounds. Coordinate hardware with Frame/Door manufacturer. Operation: Doors normally held open by wall magnetic holders. In the event of loss of power or activation of fire alarm, doors release to close and latch. Magnetic holders tied into fire alarm system. Coordinate wiring / installation with GC / EC / Security Vendor.

Set #050 - Restricted Corr - Card Access

Doors: 3018

Set #050 - Restricted Corr - Card Access

4	Pivot	75233	606	DM
2	Floor Closer	BTS 75V/F BF	606	DM
2	Terrazo Pan	TP75V		DM
1	Exit Device	C FL TS 2801 LBR	606	PR
1	Exit Device	C FL MLR TS 2803 X 4903D LBR	606	PR
1	Rim Cylinder	12E-72 PATD	606	BE
2	Overhead Stop	S1020 SL Series	US4	AB
	NOTE: See special template			
2	Door Position Switch	9540	BLACK	RC
2	Power Transfer	EPT-12C		PR
1	Wiring Diagram	WIRING DIAGRAM FURNISHED BY HWDE. SUPPLIER		BY
1	Card Reader	CARD READER SUPPLIED UNDER DIVISION 28		BY
1	Remote Release	REMOTE RELEASE SUPPLIED UNDER DIVISION 28		BY
1	Power Supply	RPSMLR2BB		PR
2	Harness	WH-6E		ST
2	Harness	WH-192P		ST
2	Harness	WH-XXP (Length as REQ'D)		ST
1	Sound Seal	5020C @ Head & Jambs		NA
1	Meeting Stile Seal	5070 CL		NA

NOTE: Door Weight Not To Exceed 260 Pounds. Coordinate hardware with Frame/Door manufacturer. Verify template with ABH. Operation: Doors closed and locked. Presentation of valid credential or Remote retracts active leaf latchbolt allowing authorized entry. Egress always allowed through both door leaves. TS switch to act as Request to Exit. Mechanical key override. All wiring and conduit by electrical contractor. Coordinate wiring and installation with EC / GC / Security Vendor.

Set #051 - Public Conference

Doors: 4202A, 4203A

4	Butt Hinge	FBB179 4.5" x 4.5" NRP	4	ST
1	Classroom Lockset	45H-7R14R PATD	606	BE
1	Closer	8916 S-DS	606	DM
1	Kick Plate	K0050 10" x 2" LDW B4E-Heavy CSK	606	TR
1	Sound Seal	5020C @ Head & Jambs		NA

Set #052 - Public Conference

Doors: 2319, 4202B, 4203B

4	Butt Hinge	FBB179 4.5" x 4.5"	26D	ST
1	Passage Set	45H-0N14R	626	BE
1	Wall Bumper	1270CX	626	TR
1	Sound Seal	5020C @ Head & Jambs		NA

NOTE: Hinge 4 1/2 x 5 at Door 4202B, 4203B

Set #053 - Area - Card Access - Delay Egress

Doors: 4210B, 4210C, 4215B, 4215C, 4862, 4861

4	Butt Hinge	FBB168 4.5" x 4.5" NRP	4	ST
1	Exit Device	DE E2103 X 4908D FSE	606	PR
1	Rim Cylinder	12E-72 PATD	606	BE
1	Mortise Cylinder	1E-74 PATD	606	BE
1	Closer	8916 AF89	606	DM
1	Kick Plate	K0050 10" x 2" LDW B4E-Heavy CSK	606	TR
1	Wall Bumper	1270CX	606	TR
1	Door Position Switch	9540	BLACK	RC
1	Wiring Diagram	WIRING DIAGRAM FURNISHED BY HWDE. SUPPLIER		BY
2	Card Reader	CARD READER SUPPLIED UNDER DIVISION 28		BY
1	Power Supply - DE Device	PS161-6		PR
1	Power Transfer	EPT-5		PR
1	Sound Seal	5020C @ Head & Jambs		NA

NOTE: Verify door size and swing. Operation: Door is normally closed and locked. Presenting valid credential at card reader either side releases secure lever allowing entry. Key override will bypass card reader and permit ingress.
Presenting valid credential on egress side of door will shunt alarm and delay process allowing immediate egress.
Delayed Egress: Depressing exit device touchpad for longer than nuisance period starts a 15 second alarmed delay. After 15 seconds, exit device releases allowing egress. Once alarm has been initiated reset is done by mechanical key at the exit device.
Upon loss of power event or building fire alarm system activation door will remain closed and locked and immediate egress is allowed.
Coordinate wiring / installation with GC / EC / Security Vendor.

Set #054 - Courtroom Area, Corr - Card Access

Doors: 4026B, 4210D, 5203

Set #054 - Courtroom Area, Corr - Card Access

4	Butt Hinge	FBB179 4.5" x 4.5" NRP	26D	ST
1	Exit Device	C MLR TS 2103 x 4903D LD Split Fin 630 Outside Trim	606	PR
1	Rim Cylinder	12E-72 PATD	626	BE
1	Closer	8916 S-DS	606	DM
1	Kick Plate	K0050 10" x 2" LDW B4E-Heavy CSK	606	TR
1	Door Position Switch	9540	BLACK	RC
1	Power Transfer	EPT-12C		PR
1	Wiring Diagram	WIRING DIAGRAM FURNISHED BY HWDE. SUPPLIER		BY
1	Card Reader	CARD READER SUPPLIED UNDER DIVISION 28		BY
1	Power Supply	RPSMLR2BB		PR
1	Harness	WH-6E		ST
1	Harness	WH-192P		ST
1	Harness	WH-XXP (Length as REQ'D)		ST
1	Sound Seal	5020C @ Head & Jambs		NA

NOTE: Operation: Door normally closed and locked. Presentation of valid credential retracts exit device latchbolt allowing entry. Free egress at all times. Mechanical key by-pass. TS switch to act as Request to exit. Coordinate wiring / installation with GC / EC / Security Vendor.

Set #055 - Courtroom Area - Card Access

Doors: 4025

4	Butt Hinge	FBB168 5" X 4.5" NRP	26D	ST
1	Exit Device	C MLR TS 2103 X 4903D LD	630	PR
1	Rim Cylinder	12E-72 PATD	626	BE
1	Closer	8916 S-DS	689	DM
1	Kick Plate	K0050 10" x 1" LDW B4E-Heavy CSK	630	TR
1	Power Transfer	EPT-12C		PR
1	Wiring Diagram	WIRING DIAGRAM FURNISHED BY HWDE. SUPPLIER		BY
1	Card Reader	CARD READER SUPPLIED UNDER DIVISION 28		BY
1	Power Supply	RPSMLR2BB		PR
1	Harness	WH-XXP (Length as REQ'D)		ST
1	Harness	WH-6E		ST
1	Harness	WH-192P		ST
1	Sound Seal	5020C @ Head & Jambs		NA

NOTE: Operation: Door normally closed and locked. Presentation of valid credential to reader retracts exit device latchbolt allowing entry. Free egress at all times. Mechanical key by-pass. TS switch to act as Request to exit. Coordinate wiring / installation with GC / EC / Security Vendor.

Set #056 - Corridor - D/E - Card Access - Mag Lock

Doors: 4024A, 4026A, 5024, 5026

Set #056 - Corridor - D/E - Card Access - Mag Lock

8	Butt Hinge	FBB168 5" X 4.5" NRP	26D	ST
1	Exit Device	2201 LBR	630	PR
1	Push Plate	To be Selected	630	TR
1	Magnetic Lock	EML310 BA DP x Z Top jamb inswing Mtg Brk	626	DM
1	Closer	8916 IS	689	DM
1	Closer	8916 S-DS	689	DM
2	Kick Plate	K0050 10" x 1" LDW B4E-Heavy CSK	630	TR
2	Mop Plate	KM050 10" x 1" LDW B4E-Heavy CSK	630	TR
1	Card Reader	CARD READER SUPPLIED UNDER DIVISION 28		BY
1	Power Supply	POWER SUPPLY SUPPLIED UNDER DIVISION 28		BY
1	Remote Release Aiphone	REMOTE RELEASE / AIPHONE BY SECURITY VENDOR		BY
1	Emergency Button	BUTTON SUPPLIED UNDER DIVISION 28		BY
1	Sound Seal	5020C @ Head & Jambs		NA
1	Meeting Stile Seal	5070 CL		NA

NOTE: Operation: Doors closed and locked. Egress by exit device push bar. Entry by presentation of valid credential to card reader or remote release deenergize magnetic lock allowing authorized entry. Emergency button by (others) to release magnetic lock for entry. All wiring and conduit by electrical contractor. Coordinate wiring and installation with EC / GC / Security Vendor.

Set #057 - Corridor - D/E - Card Access - Mag Lock

Doors: 3024A / B

6	Butt Hinge	FBB168 4.5" x 4.5" NRP	4	ST
1	Exit Device	2201 LBR	630	PR
1	Push Plate	To be Selected	630	TR
1	Magnetic Lock	EML310 BA DP x Z Top jamb inswing Mtg Brk	626	DM
1	Closer	8916 IS	689	DM
1	Closer	8916 S-DS	689	DM
2	Kick Plate	K0050 10" x 1" LDW B4E-Heavy CSK	630	TR
2	Mop Plate	KM050 10" x 1" LDW B4E-Heavy CSK	630	TR
1	Card Reader	CARD READER SUPPLIED UNDER DIVISION 28		BY
1	Power Supply	POWER SUPPLY SUPPLIED UNDER DIVISION 28		BY
1	Remote Release Aiphone	REMOTE RELEASE / AIPHONE BY SECURITY VENDOR		BY
1	Emergency Button	BUTTON SUPPLIED UNDER DIVISION 28		BY
1	Sound Seal	5020C @ Head & Jambs		NA
1	Meeting Stile Seal	5070 CL		NA

NOTE: Operation: Doors closed and locked. Egress by exit device push bar. Entry by presentation of valid credential to card reader or remote release deenergize magnetic lock allowing authorized entry. Emergency button by (others) to release magnetic lock for entry. All wiring and conduit by electrical contractor. Coordinate wiring and installation with EC / GC / Security Vendor.

Set #058 - Janitor

Doors: 2124

4	Butt Hinge	FBB179 4.5" x 4.5" NRP	26D	ST
1	Storeroom Lockset	45H-7D14R PATD	626	BE
1	Mop Plate	KM050 10" x 1" LDW B4E-Heavy CSK	630	TR
1	Wall Bumper	1270CX	626	TR
3	Silencer	1229A	GREY	TR

Set #059 - Equip & Supplies, Storage, Staff

Doors: 1415, 2101, 2108, 2307, 2310

4	Butt Hinge	FBB179 4.5" x 4.5"	26D	ST
1	Storeroom Lockset	45H-7D14R PATD	626	BE
1	Wall Bumper	1270CX	626	TR
3	Silencer	1229A	GREY	TR

Set #060 - Storage, Packing, Vault

Doors: 2304B, 2401, 2402

4	Butt Hinge	FBB179 4.5" x 4.5"	26D	ST
1	Storeroom Lockset	45H-7D14R PATD	626	BE
1	Closer	8916 AF89	689	DM
1	Kick Plate	K0050 10" x 2" LDW B4E-Heavy CSK	630	TR
1	Wall Bumper	1270CX	626	TR
3	Silencer	1229A	GREY	TR

Set #061 - Storage, Production

Doors: 2304A, 2308

4	Butt Hinge	FBB179 4.5" x 4.5" NRP	26D	ST
1	Storeroom Lockset	45H-7D14R PATD	626	BE
1	Closer	8916 SPA	689	DM
1	Kick Plate	K0050 10" x 2" LDW B4E-Heavy CSK	630	TR
1	Wall Bumper	1270CX	626	TR
3	Silencer	1229A	GREY	TR

Set #062 - Mediation Corr

Doors: 2200

4	Butt Hinge	FBB168 4.5" x 4.5" NRP	4	ST
1	Exit Device	2108 X 4908D LD	606	PR
1	Rim Cylinder	12E-72 PATD	606	BE
1	Closer	8916 S-DS	606	DM
1	Kick Plate	K0050 10" x 2" LDW B4E-Heavy CSK	606	TR
1	Sound Seal	5020C @ Head & Jambs		NA

Set #063 - Training - Card Access

Doors: 2306

Set #063 - Training - Card Access

4	Butt Hinge	FBB168 4.5" x 4.5" NRP	4	ST
1	Rim Cylinder	12E-72 PATD	606	BE
1	Door Pull	AP433 72" N	606	TR
1	Closer	8916 S-DS	606	DM
1	Kick Plate	K0050 10" x 2" LDW B4E-Heavy CSK	606	TR
1	Door Position Switch	9540	BLACK	RC
1	Power Transfer	EPT-12C		PR
1	Wiring Diagram	WIRING DIAGRAM FURNISHED BY HWDE. SUPPLIER		BY
1	Card Reader	CARD READER SUPPLIED UNDER DIVISION 28		BY
1	Power Supply	RPSMLR2BB		PR
1	Harness	WH-6E		ST
1	Exit Device	C MLR TS 2103 LD	606	PR
1	Harness	WH-192P		ST
1	Harness	WH-XXP (Length as REQ'D)		ST
1	Sound Seal	5020C @ Head & Jambs		NA

NOTE: Operation: Door normally closed and locked. Presentation of valid credential retracts exit device latchbolt allowing entry. Free egress at all times. Mechanical key by-pass. TS switch to act as Request to exit. Coordinate wiring / installation with GC / EC / Security Vendor.

Set #064 - Office - Card Access

Doors: 1302, 2025B, 2309, 2400

4	Butt Hinge	FBB179 4.5" x 4.5" NRP	26D	ST
1	Exit Device	C MLR TS 2103 X 4903D LD	630	PR
1	Rim Cylinder	12E-72 PATD	626	BE
1	Closer	8916 S-DS	689	DM
1	Kick Plate	K0050 10" x 2" LDW B4E-Heavy CSK	630	TR
1	Door Position Switch	9540	BLACK	RC
1	Power Transfer	EPT-12C		PR
1	Wiring Diagram	WIRING DIAGRAM FURNISHED BY HWDE. SUPPLIER		BY
1	Card Reader	CARD READER SUPPLIED UNDER DIVISION 28		BY
1	Power Supply	RPSMLR2BB		PR
1	Harness	WH-6E		ST
1	Harness	WH-192P		ST
1	Harness	WH-XXP (Length as REQ'D)		ST
1	Sound Seal	5020C @ Head & Jambs		NA

NOTE: Operation: Door normally closed and locked. Presentation of valid credential retracts exit device latchbolt allowing entry. Free egress at all times. Mechanical key by-pass. TS switch to act as Request to exit. Coordinate wiring / installation with GC / EC / Security Vendor.

Set #065 - Corridor, Office - Card Access

Doors: 1027, 1403, 2009A, 2301

Set #065 - Corridor, Office - Card Access

4	Butt Hinge	FBB179 4.5" x 4.5" NRP	26D	ST
1	Exit Device	C MLR TS 2103 X 4903D LD	630	PR
1	Rim Cylinder	12E-72 PATD	626	BE
1	Closer	8916 SPA	689	DM
1	Kick Plate	K0050 10" x 2" LDW B4E-Heavy CSK	630	TR
1	Door Position Switch	9540	BLACK	RC
1	Power Transfer	EPT-12C		PR
1	Wiring Diagram	WIRING DIAGRAM FURNISHED BY HWDE. SUPPLIER		BY
1	Card Reader	CARD READER SUPPLIED UNDER DIVISION 28		BY
1	Power Supply	RPSMLR2BB		PR
1	Harness	WH-6E		ST
1	Harness	WH-192P		ST
1	Harness	WH-XXP (Length as REQ'D)		ST
1	Wall Bumper	1270CX	626	TR
1	Sound Seal	5020C @ Head & Jambs		NA

NOTE: Operation: Door normally closed and locked. Presentation of valid credential retracts exit device latchbolt allowing entry. Free egress at all times. Mechanical key by-pass. TS switch to act as Request to exit. Coordinate wiring / installation with GC / EC / Security Vendor.

Set #066 - Corr, Office - Card Access - Alarm

Doors: 2025A, 2025C

4	Butt Hinge	FBB179 4.5" x 4.5" NRP	26D	ST
1	Exit Device	E2103 X 4908D ALW FSE	630	PR
1	Rim Cylinder	12E-72 PATD	626	BE
1	Mortise Cylinder	1E-74 PATD	626	BE
1	Closer	8916 S-DS	689	DM
1	Kick Plate	K0050 10" x 2" LDW B4E-Heavy CSK	630	TR
1	Door Position Switch	9540	BLACK	RC
1	Wiring Diagram	WIRING DIAGRAM FURNISHED BY HWDE. SUPPLIER		BY
2	Card Reader	CARD READER SUPPLIED UNDER DIVISION 28		BY
1	Power Supply	POWER SUPPLY SUPPLIED UNDER DIVISION 28		BY
1	Wiring Harness	WH495		PR
1	Power Transfer	EPT-5		PR
1	Sound Seal	5020C @ Head & Jambs		NA

NOTE: Operation: Door normally closed and locked. Presentation of valid credential to Corridor side reader releases secure lever exit trim allowing entry to Area. Presentation of valid credential to Inside reader shunts alarm when egressing to outside corridor. Mechanical key by-pass. Coordinate wiring / installation with GC / EC / Security Vendor. In the event of power loss door will remain locked. All Wiring by electrical contractor.

Set #067 - Corridor - Card Access - Delay Egress

Doors: 1025A, 1026, 2205

Set #067 - Corridor - Card Access - Delay Egress

4	Butt Hinge	FBB179 4.5" x 4.5" NRP	26D	ST
1	Exit Device	DE E2103 X 4908D FSE	630	PR
1	Rim Cylinder	12E-72 PATD	626	BE
1	Mortise Cylinder	1E-74 PATD	626	BE
1	Closer	8916 SPA	689	DM
1	Kick Plate	K0050 10" x 2" LDW B4E-Heavy CSK	630	TR
1	Wall Bumper	1270CX	626	TR
1	Door Position Switch	9540	BLACK	RC
1	Wiring Diagram	WIRING DIAGRAM FURNISHED BY HWDE. SUPPLIER		BY
2	Card Reader	CARD READER SUPPLIED UNDER DIVISION 28		BY
1	Power Supply - DE Device	PS161-6		PR
1	Power Transfer	EPT-5		PR
1	Gasketing	2525C @ Head & Jambs		NA

NOTE: Operation: Door is normally closed and locked. Presenting valid credential at card reader either side releases secure lever allowing entry. Key override will bypass card reader and permit ingress.
Presenting valid credential on egress side of door will shunt alarm and delay process allowing immediate egress.
Delayed Egress: Depressing exit device touchpad for longer than nuisance period starts a 15 second alarmed delay. After 15 seconds, exit device releases allowing egress. Once alarm has been initiated reset is done by mechanical key at the exit device.
Upon loss of power event door will remain closed and locked and immediate egress is allowed.
Coordinate wiring / installation with GC / EC / Security Vendor.

Set #068 - Mech Rm, Counter- Card Access

Doors: 1301, 2022

4	Butt Hinge	FBB179 4.5" x 4.5" NRP	26D	ST
1	Elec Lockset	45HW-7DEU14R PATD C RQE	626	BE
1	Closer	8916 SPA	689	DM
1	Kick Plate	K0050 10" x 2" LDW B4E-Heavy CSK	630	TR
1	Wall Bumper	1270CX	626	TR
1	Door Position Switch	9540	BLACK	RC
1	Power Transfer	EPT-12C		PR
1	Wiring Diagram	WIRING DIAGRAM FURNISHED BY HWDE. SUPPLIER		BY
1	Card Reader	CARD READER SUPPLIED UNDER DIVISION 28		BY
1	Harness	WH-6E		ST
1	Harness	WH-192P		ST
1	Harness	WH-XXP (Length as REQ'D)		ST
1	Power Supply	POWER SUPPLY SUPPLIED UNDER DIVISION 28		BY
3	Silencer	1229A	GREY	TR

Set #068 - Mech Rm, Counter- Card Access

NOTE: Operation: Door normally closed and locked. Presentation of valid credential releases secure lever allowing entry. Free egress at all times. Mechanical key by-pass. Lockset is Fail-Secure-Upon loss of power door remains secure. Coordinate wiring / installation with GC / EC / Security Vendor.

Set #069 - Stacks Storage - Card Access

Doors: 2123

4	Butt Hinge	FBB179 4.5" x 4.5"	26D	ST
1	Elec Lockset	45HW-7DEU14R PATD C RQE	626	BE
1	Closer	8916 IS	606	DM
1	Kick Plate	K0050 10" x 2" LDW B4E-Heavy CSK	630	TR
1	Door Position Switch	9540	BLACK	RC
1	Power Transfer	EPT-12C		PR
1	Wiring Diagram	WIRING DIAGRAM FURNISHED BY HWDE. SUPPLIER		BY
1	Card Reader Dual Validation	CARD READER SUPPLIED UNDER DIVISION 28		BY
1	Harness	WH-6E		ST
1	Harness	WH-192P		ST
1	Harness	WH-XXP (Length as REQ'D)		ST
1	Power Supply	POWER SUPPLY SUPPLIED UNDER DIVISION 28		BY
3	Silencer	1229A	GREY	TR

NOTE: Operation: Door normally closed and locked. Presentation of Dual Validation credentials releases secure lever allowing entry. Free egress at all times. Mechanical key by-pass. Lockset is Fail-Secure-Upon loss of power door remains secure. Coordinate wiring / installation with GC / EC / Security Vendor.

Set #070 - Mail Supplies

Doors: 2106B

4	Butt Hinge	FBB179 4.5" x 4.5" NRP	4	ST
1	Classroom Lockset	45H-7R14R PATD	626	BE
1	Wall Bumper	1270CX	626	TR
3	Silencer	1229A	GREY	TR

Set #071 - Corridor - Card Access - Remote

Doors: 2100, 2305

Set #071 - Corridor - Card Access - Remote

4	Butt Hinge	FBB168 4.5" x 4.5" NRP	26D	ST
1	Exit Device	C MLR TS 2103 LD	630	PR
1	Rim Cylinder	12E-72 PATD	626	BE
1	Door Pull	AP433 72" N	630	TR
1	Closer	8916 S-DS	689	DM
1	Kick Plate	K0050 10" x 2" LDW B4E-Heavy CSK	630	TR
1	Door Position Switch	9540	BLACK	RC
1	Power Transfer	EPT-12C		PR
1	Wiring Diagram	WIRING DIAGRAM FURNISHED BY HWDE. SUPPLIER		BY
1	Card Reader	CARD READER SUPPLIED UNDER DIVISION 28		BY
1	Harness	WH-6E		ST
1	Harness	WH-192P		ST
1	Harness	WH-XXP (Length as REQ'D)		ST
1	Remote Release	REMOTE RELEASE SUPPLIED UNDER DIVISION 28		BY
1	Power Supply	RPSMLR2BB		PR
1	Sound Seal	5020C @ Head & Jambs		NA

NOTE: Operation: Door normally closed and locked. Presentation of valid credential or Remote Release retracts exit device latchbolt allowing entry. Free egress at all times. Mechanical key by-pass. TS switch to act as Request to exit. Coordinate wiring / installation with GC / EC / Security Vendor.

Set #072 - Corridor, Office - Card Access - Remote

Doors: 1300B, 1400, B030

4	Butt Hinge	FBB179 4.5" x 4.5" NRP	4	ST
1	Exit Device	C MLR TS 2103 X 4903D LD	630	PR
1	Rim Cylinder	12E-72 PATD	626	BE
1	Closer	8916 SPA	689	DM
1	Kick Plate	K0050 10" x 2" LDW B4E-Heavy CSK	630	TR
1	Wall Bumper	1270CX	626	TR
1	Door Position Switch	9540	BLACK	RC
1	Power Transfer	EPT-12C		PR
1	Wiring Diagram	WIRING DIAGRAM FURNISHED BY HWDE. SUPPLIER		BY
1	Card Reader	CARD READER SUPPLIED UNDER DIVISION 28		BY
1	Harness	WH-6E		ST
1	Harness	WH-192P		ST
1	Harness	WH-XXP (Length as REQ'D)		ST
1	Remote Release	REMOTE RELEASE SUPPLIED UNDER DIVISION 28		BY
1	Power Supply	RPSMLR2BB		PR
3	Silencer	1229A	GREY	TR

Set #072 - Corridor, Office - Card Access - Remote

NOTE: Operation: Door normally closed and locked. Presentation of valid credential or Remote Release retracts exit device latchbolt allowing entry. Free egress at all times. Mechanical key by-pass. TS switch to act as Request to exit. Coordinate wiring / installation with GC / EC / Security Vendor.

Set #073 - Recep, Dept Circulation - Card Access

Doors: 1018B, 1100, 2300

8	Butt Hinge	FBB168 4.5" x 4.5" NRP	4	ST
1	Exit Device	C MLR TS 2701 LBR LD	630	PR
1	Exit Device	C MLR TS 2703 LBR LD	630	PR
1	Rim Cylinder	12E-72 PATD	626	BE
2	Closer	8916 S-DS	689	DM
2	Door Pull	AP433 72" N	630	TR
2	Door Position Switch	9540	BLACK	RC
2	Power Transfer	EPT-12C		PR
1	Wiring Diagram	WIRING DIAGRAM FURNISHED BY HWDE. SUPPLIER		BY
1	Card Reader	CARD READER SUPPLIED UNDER DIVISION 28		BY
1	Power Supply	RPSMLR2BB		PR
2	Harness	WH-6E		ST
2	Harness	WH-192P		ST
2	Harness	WH-XXP (Length as REQ'D)		ST
1	Sound Seal	5020C @ Head & Jambs		NA
1	Meeting Stile Seal	5070 CL		NA

NOTE: Operation: Access control system to schedule exit device latchbolts to be retracted for manual push / pull operation. Closed Hours: Doors closed and locked. Presentation of valid credential to card reader will retract active leaf latchbolt allowing authorized entry. Egress always allowed through both door leaves. TS switch to act as Request to exit. Mechanical key override. All wiring and conduit by electrical contractor. Coordinate wiring and installation with EC / GC / Security Vendor.

Set #074 - Storage, Packing, Vault

Doors: 2409

4	Butt Hinge	FBB179 4.5" x 4.5"	26D	ST
1	Storeroom Lockset	45H-7D14R PATD	626	BE
1	Closer	8916 AF89	689	DM
1	Kick Plate	K0050 10" x 2" LDW B4E-Heavy CSK	630	TR
1	Wall Bumper	1270CX	626	TR
1	Sound Seal	5020C @ Head & Jambs		NA

Set #075 - Training - Delay Egress

Doors: 2026

Set #075 - Training - Delay Egress

4	Butt Hinge	FBB179 4.5" x 4.5" NRP	26D	ST
1	Exit Device	DE 2114 X 4914D LD	630	PR
1	Mortise Cylinder	1E-74 PATD	626	BE
1	Closer	8916 SPA	689	DM
1	Kick Plate	K0050 10" x 2" LDW B4E-Heavy CSK	630	TR
1	Wall Bumper	1270CX	626	TR
1	Door Position Switch	9540	BLACK	RC
1	Wiring Diagram	WIRING DIAGRAM FURNISHED BY HWDE. SUPPLIER		BY
1	Card Reader	CARD READER SUPPLIED UNDER DIVISION 28		BY
1	Power Supply - DE Device	PS161-6		PR
1	Power Transfer	EPT-5		PR
1	Gasketing	2525C @ Head & Jambs		NA

NOTE: Operation: Free entry at all times from outside. Delayed egress. Presenting valid credential on egress side of door will shunt alarm and delay process allowing immediate egress. Delayed Egress: Depressing exit device touchpad for longer than nuisance period starts a 15 second alarmed delay. After 15 seconds, exit device releases allowing egress. Once alarm has been initiated reset is done by mechanical key at the exit device.
Upon loss of power door will remain closed and immediate egress is allowed.
Wiring from Power Supply to Exit Device by EC.
Coordinate with electrical, fire alarm, and security.

Set #076 - Stacks Storage - Card Access

Doors: 1202

4	Butt Hinge	FBB179 4.5" x 4.5"	26D	ST
1	Elec Lock Fail Secure	45HW-7WEU14R PATD C RQE	626	BE
1	Closer	8916 SPA	689	DM
1	Kick Plate	K0050 10" x 2" LDW B4E-Heavy CSK	630	TR
1	Door Position Switch	9540	BLACK	RC
1	Power Transfer	EPT-12C		PR
1	Wiring Diagram	WIRING DIAGRAM FURNISHED BY HWDE. SUPPLIER		BY
2	Card Reader	CARD READER SUPPLIED UNDER DIVISION 28		BY
1	Harness	WH-6E		ST
1	Harness	WH-192P		ST
1	Harness	WH-XXP (Length as REQ'D)		ST
1	Power Supply	POWER SUPPLY SUPPLIED UNDER DIVISION 28		BY
3	Silencer	1229A	GREY	TR

NOTE: Operation: Door normally closed and locked. Presentation of credentials to card reader eithed side releases secure lever allowing entry. Free egress at all times. Mechanical key by-pass. Lockset is Fail-Secure-Upon loss of power door remains secure from both sides.
Coordinate wiring / installation with GC / EC / Security Vendor.

Set #077 - Museum - Card Access - Delay Egress FSE

Doors: 1025B

8	Butt Hinge	FBB168 4.5" x 4.5" NRP	26D	ST
1	Exit Device	DE 2701 LBR	630	PR
1	Exit Device	DE E2703 X 4908D FSE LBR	630	PR
1	Rim Cylinder	12E-72 PATD	626	BE
1	Mortise Cylinder	1E-74 PATD	626	BE
2	Closer	8916 SPA	689	DM
2	Wall Bumper	1270CX	626	TR
2	Door Position Switch	9540	BLACK	RC
2	Power Transfer	EPT-5		PR
1	Wiring Diagram	WIRING DIAGRAM FURNISHED BY HWDE. SUPPLIER		BY
2	Card Reader	CARD READER SUPPLIED UNDER DIVISION 28		BY
1	Power Supply	PS161-6		PR
1	Sound Seal	5020C @ Head & Jambs		NA
1	Meeting Stile Seal	5070 CL		NA

NOTE: Operation: Door is normally closed and locked. Presenting valid credential at outside card reader releases secure lever allowing entry. Key override will bypass card reader and permit ingress.
Presenting valid credential on egress side of door will shunt alarm and delay process allowing immediate egress.
Delayed Egress: Depressing exit device touchpad for longer than nuisance period starts a 15 second alarmed delay. After 15 seconds, exit device releases allowing egress. Once alarm has been initiated reset is done by mechanical key at the exit device.
Upon loss of power event Doors will remain closed and locked and immediate egress is allowed.
Wiring from Power Supply to Exit Device by EC.
Coordinate with electrical, fire alarm, and security.

Set #078 - Records, Fire Command - Card Access

Doors: 1417, 1418, B042A

Set #078 - Records, Fire Command - Card Access

4	Butt Hinge	FBB179 4.5" x 4.5"	26D	ST
1	Elec Lockset	45HW-7DEU14R PATD C RQE	626	BE
1	Closer	8916 AF89	689	DM
1	Kick Plate	K0050 10" x 2" LDW B4E-Heavy CSK	630	TR
1	Wall Bumper	1270CX	626	TR
1	Door Position Switch	9540	BLACK	RC
1	Power Transfer	EPT-12C		PR
1	Wiring Diagram	WIRING DIAGRAM FURNISHED BY HWDE. SUPPLIER		BY
1	Card Reader	CARD READER SUPPLIED UNDER DIVISION 28		BY
1	Harness	WH-6E		ST
1	Harness	WH-192P		ST
1	Harness	WH-XXP (Length as REQ'D)		ST
1	Power Supply	POWER SUPPLY SUPPLIED UNDER DIVISION 28		BY
1	Gasketing	2525 C @ Head & Jambs		NA

NOTE: Operation: Door normally closed and locked. Presentation of valid credential releases secure lever allowing entry. Free egress at all times. Mechanical key by-pass. Lockset is Fail-Secure-Upon loss of power door remains secure. Coordinate wiring / installation with GC / EC / Security Vendor.

Set #079 - Corridor - Card Access

Doors: 1300A

4	Butt Hinge	FBB179 4.5" x 4.5" NRP	26D	ST
1	Exit Device	C MLR TS 2103 X 4903D LD	630	PR
1	Rim Cylinder	12E-72 PATD	626	BE
1	Closer	8916 SPA	689	DM
1	Kick Plate	K0050 10" x 2" LDW B4E-Heavy CSK	630	TR
1	Door Position Switch	9540	BLACK	RC
1	Power Transfer	EPT-12C		PR
1	Wiring Diagram	WIRING DIAGRAM FURNISHED BY HWDE. SUPPLIER		BY
1	Card Reader	CARD READER SUPPLIED UNDER DIVISION 28		BY
1	Power Supply	RPSMLR2BB		PR
1	Harness	WH-6E		ST
1	Harness	WH-192P		ST
1	Harness	WH-XXP (Length as REQ'D)		ST
1	Wall Bumper	1270CX	626	TR
3	Silencer	1229A	GREY	TR

NOTE: Operation: Door normally closed and locked. Presentation of valid credential retracts exit device latchbolt allowing entry. Free egress at all times. Mechanical key by-pass. TS switch to act as Request to exit. Coordinate wiring / installation with GC / EC / Security Vendor.

Set #080 - Recep Office

Doors: 1413

Set #080 - Recep Office

4	Butt Hinge	FBB179 4.5" x 4.5"	26D	ST
1	Classroom Lockset	45H-7R14R PATD	626	BE
1	Overhead Stop	1020 SL Series	US32D	AB
1	Sound Seal	5020C @ Head & Jambs		NA

Set #081 - Telecom - Card Access

Doors: B003

3	Butt Hinge	FBB179 4.5" x 4.5"	26D	ST
1	Elec Lockset	45HW-7DEU14R PATD C RQE	626	BE
1	Closer	8916 IS	689	DM
1	Kick Plate	K0050 10" x 2" LDW B4E-Heavy CSK	630	TR
1	Door Position Switch	9540	BLACK	RC
1	Power Transfer	EPT-12C		PR
1	Wiring Diagram	WIRING DIAGRAM FURNISHED BY HWDE. SUPPLIER		BY
1	Card Reader	CARD READER SUPPLIED UNDER DIVISION 28		BY
1	Harness	WH-6E		ST
1	Harness	WH-192P		ST
1	Harness	WH-XXP (Length as REQ'D)		ST
1	Power Supply	POWER SUPPLY SUPPLIED UNDER DIVISION 28		BY
1	Gasketing	2525 C @ Head & Jambs		NA

NOTE: Operation: Door normally closed and locked. Presentation of valid credential releases secure lever allowing entry. Free egress at all times. Mechanical key by-pass. Lockset is Fail-Secure-Upon loss of power door remains secure. Coordinate wiring / installation with GC / EC / Security Vendor.

Set #082 - Elev Mach Rm - Card Access

Doors: B004

3	Butt Hinge	FBB179 4.5" x 4.5" NRP	26D	ST
1	Elec Lockset	45HW-7DEU14R PATD C RQE	626	BE
1	Closer	8916 SPA	689	DM
1	Kick Plate	K0050 10" x 2" LDW B4E-Heavy CSK	630	TR
1	Wall Bumper	1270CX	626	TR
1	Door Position Switch	9540	BLACK	RC
1	Power Transfer	EPT-12C		PR
1	Wiring Diagram	WIRING DIAGRAM FURNISHED BY HWDE. SUPPLIER		BY
1	Card Reader	CARD READER SUPPLIED UNDER DIVISION 28		BY
1	Harness	WH-6E		ST
1	Harness	WH-192P		ST
1	Harness	WH-XXP (Length as REQ'D)		ST
1	Power Supply	POWER SUPPLY SUPPLIED UNDER DIVISION 28		BY
1	Gasketing	2525 C @ Head & Jambs		NA

Set #082 - Elev Mach Rm - Card Access

NOTE: Operation: Door normally closed and locked. Presentation of valid credential releases secure lever allowing entry. Free egress at all times. Mechanical key by-pass. Lockset is Fail-Secure-Upon loss of power door remains secure. Coordinate wiring / installation with GC / EC / Security Vendor.

Set #083 - Elev Lobby - Mag Holders

Doors: B002

8	Butt Hinge	FBB179 4.5" x 4.5"	26D	ST
1	Exit Device	FL 2201 LBR	630	PR
1	Exit Device	FL 2214 X 4914D LBR	630	PR
2	Magnetic Holder	EM 504-24120	689	DM
2	Closer	8916 SPA	689	DM
2	Kick Plate	K0050 10" x 1" LDW B4E-Heavy CSK	630	TR
1	Meeting Stile Seal	5070 CL		NA
1	Gasketing	2525C @ Head & Jambs		NA

NOTE: Operation: Doors normally held open by wall magnetic holders. In the event of loss of power or activation of fire alarm, doors release to close and latch. Magnetic holders tied into fire alarm system. Coordinate wiring / installation with GC / EC / Security Vendor.

Set #084 - Locker Vest - Card Access

Doors: B006

3	Butt Hinge	FBB179 4.5" x 4.5" NRP	26D	ST
1	Elec Lockset	45HW-7DEU14R PATD C RQE	626	BE
1	Closer	8916 S-DS	689	DM
1	Kick Plate	K0050 10" x 2" LDW B4E-Heavy CSK	630	TR
1	Door Position Switch	9540	BLACK	RC
1	Power Transfer	EPT-12C		PR
1	Wiring Diagram	WIRING DIAGRAM FURNISHED BY HWDE. SUPPLIER		BY
1	Card Reader	CARD READER SUPPLIED UNDER DIVISION 28		BY
1	Harness	WH-6E		ST
1	Harness	WH-192P		ST
1	Harness	WH-XXP (Length as REQ'D)		ST
1	Power Supply	POWER SUPPLY SUPPLIED UNDER DIVISION 28		BY
3	Silencer	1229A	GREY	TR

NOTE: Door normally closed and locked. Presentation of valid credential releases secure lever allowing entry. Free egress at all times. Mechanical key by-pass. Lockset is Fail-Secure-Upon loss of power door remains secure. Coordinate wiring / installation with GC / EC / Security Vendor.

Set #085 - Locker Room

Doors: B007

Set #085 - Locker Room

3	Butt Hinge	FBB179 4.5" x 4.5"	26D	ST
1	Pull Plate	1035-3	630	TR
1	Push Plate	1001-9	630	TR
1	Closer	8916 SPA	689	DM
1	Kick Plate	K0050 10" x 2" LDW B4E-Heavy CSK	630	TR
1	Wall Bumper	1270CX	626	TR
3	Silencer	1229A	GREY	TR

Set #086 - Toilet

Doors: B050

4	Butt Hinge	FBB179 4.5" x 4.5"	26D	ST
1	Privacy Set	45H-0LT14R VIB	626	BE
1	Closer	8916 SPA	689	DM
1	Kick Plate	K0050 10" x 2" LDW B4E-Heavy CSK	630	TR
1	Wall Bumper	1270CX	626	TR
1	Gasketing	2525 C @ Head & Jambs		NA

Set #087 - Janitor, Elec - Card Access

Doors: B012, B014

3	Butt Hinge	FBB179 4.5" x 4.5" NRP	26D	ST
1	Elec Lockset	45HW-7DEU14R PATD C RQE	626	BE
1	Closer	8916 S-DS	689	DM
1	Kick Plate	K0050 10" x 2" LDW B4E-Heavy CSK	630	TR
1	Mop Plate	KM050 10" x 1" LDW B4E-Heavy CSK	630	TR
1	Door Position Switch	9540	BLACK	RC
1	Power Transfer	EPT-12C		PR
1	Wiring Diagram	WIRING DIAGRAM FURNISHED BY HWDE. SUPPLIER		BY
1	Card Reader	CARD READER SUPPLIED UNDER DIVISION 28		BY
1	Harness	WH-6E		ST
1	Harness	WH-192P		ST
1	Harness	WH-XXP (Length as REQ'D)		ST
1	Power Supply	POWER SUPPLY SUPPLIED UNDER DIVISION 28		BY
3	Silencer	1229A	GREY	TR

NOTE: Operation: Door normally closed and locked. Presentation of valid credential releases secure lever allowing entry. Free egress at all times. Mechanical key by-pass. Lockset is Fail-Secure-Upon loss of power door remains secure. Coordinate wiring / installation with GC / EC / Security Vendor.

Set #088 - Wellness Ctr - Card Access

Doors: B015

Set #088 - Wellness Ctr - Card Access

4	Butt Hinge	FBB179 4.5" x 4.5" NRP	26D	ST
1	Exit Device	C FL MLR TS 2103 X 4903D	630	PR
1	Rim Cylinder	12E-72 PATD	626	BE
1	Closer	8916 S-DS	689	DM
1	Kick Plate	K0050 10" x 2" LDW B4E-Heavy CSK	630	TR
1	Door Position Switch	9540	BLACK	RC
1	Power Transfer	EPT-12C		PR
1	Wiring Diagram	WIRING DIAGRAM FURNISHED BY HWDE. SUPPLIER		BY
1	Card Reader	CARD READER SUPPLIED UNDER DIVISION 28		BY
1	Power Supply	RPSMLR2BB		PR
1	Harness	WH-6E		ST
1	Harness	WH-192P		ST
1	Harness	WH-XXP (Length as REQ'D)		ST
3	Silencer	1229A	GREY	TR

NOTE: Operation: Door normally closed and locked. Presentation of valid credential retracts exit device latchbolt allowing entry. Free egress at all times. Mechanical key by-pass. TS switch to act as Request to exit. Coordinate wiring / installation with GC / EC / Security Vendor.

Set #089 - Stair - Card Access

Doors: ST03

1	Continuous Hinge	662HD UL EPT Prep	AL	ST
1	Exit Device	C FL MLR TS 2103 X 4903D	630	PR
1	Rim Cylinder	12E-72 PATD	626	BE
1	Closer	TS93 SPT	689	DM
1	Kick Plate	K0050 10" x 2" LDW B4E-Heavy CSK	630	TR
1	Door Position Switch	9540	BLACK	RC
1	Power Transfer	EPT-12C		PR
1	Wiring Diagram	WIRING DIAGRAM FURNISHED BY HWDE. SUPPLIER		BY
1	Card Reader	CARD READER SUPPLIED UNDER DIVISION 28		BY
1	Power Supply	RPSMLR2BB		PR
1	Harness	WH-6E		ST
1	Harness	WH-192P		ST
1	Harness	WH-XXP (Length as REQ'D)		ST
1	Gasketing	2525C @ Head & Jambs		NA

NOTE: Operation: Door normally closed and locked. Presentation of valid credential retracts exit device latchbolt allowing entry. Free egress at all times. Mechanical key by-pass. TS switch to act as Request to exit. Coordinate wiring / installation with GC / EC / Security Vendor.

Set #090 - Corridor - Card Access

Doors: B018

Set #090 - Corridor - Card Access

4	Butt Hinge	FBB168 4.5" x 4.5" NRP	26D	ST
1	Exit Device	C FL MLR TS 2103 X 4903D	630	PR
1	Rim Cylinder	12E-72 PATD	626	BE
1	Closer	8916 S-DS	689	DM
1	Kick Plate	K0050 10" x 2" LDW B4E-Heavy CSK	630	TR
1	Door Position Switch	9540	BLACK	RC
1	Power Transfer	EPT-12C		PR
1	Wiring Diagram	WIRING DIAGRAM FURNISHED BY HWDE. SUPPLIER		BY
1	Card Reader	CARD READER SUPPLIED UNDER DIVISION 28		BY
1	Power Supply	RPSMLR2BB		PR
1	Harness	WH-6E		ST
1	Harness	WH-192P		ST
1	Harness	WH-XXP (Length as REQ'D)		ST
1	Gasketing	2525C @ Head & Jambs		NA

NOTE: Operation: Door normally closed and locked. Presentation of valid credential retracts exit device latchbolt allowing entry. Free egress at all times. Mechanical key by-pass. TS switch to act as Request to exit. Coordinate wiring / installation with GC / EC / Security Vendor.

Set #091 - Parking - Card Access - Delay Egress

Doors: B001A, B001B

4	Butt Hinge	FBB168 4.5" x 4.5" NRP	4	ST
1	Exit Device	DE FL E2103 X 4908D FS	630	PR
1	Rim Cylinder	12E-72 PATD	626	BE
1	Mortise Cylinder	1E-74 PATD	626	BE
1	Closer	TS93 ST	689	DM
1	Kick Plate	K0050 10" x 2" LDW B4E-Heavy CSK	630	TR
1	Door Position Switch	9540	BLACK	RC
1	Wiring Diagram	WIRING DIAGRAM FURNISHED BY HWDE. SUPPLIER		BY
2	Card Reader	CARD READER SUPPLIED UNDER DIVISION 28		BY
1	Power Supply - DE Device	PS161-6		PR
1	Power Transfer	EPT-5		PR
1	Gasketing	2525C @ Head & Jambs		NA

Set #091 - Parking - Card Access - Delay Egress

NOTE: Operation: Door is normally closed and locked. Presenting valid credential at card reader either side releases secure lever allowing entry. Key override will bypass card reader and permit ingress.
Presenting valid credential on egress side of door will shunt alarm and delay process allowing immediate egress.
Delayed Egress: Depressing exit device touchpad for longer than nuisance period starts a 15 second alarmed delay. After 15 seconds, exit device releases allowing egress. Once alarm has been initiated reset is done by mechanical key at the exit device.
Upon loss of power event or building fire alarm system activation door will remain closed and locked and immediate egress is allowed.
Coordinate wiring / installation with GC / EC / Security Vendor.

Set #092 - Exterior Sliding Door

Doors: B001C, B018B, B022C

NOTE: All hardware by door manufacturer.

Set #093 - Exterior Ballistic - Card Access

Doors: B000, B017, B022B, B040, B041

1	Continuous Hinge	662HD UL EPT Prep	AL	ST
1	Exit Device	C LS MLR TS 2103 X 4903D LD	630	PR
1	Rim Cylinder	12E-72 PATD	626	BE
1	Closer	TS93 SPT	689	DM
1	Kick Plate	K0050 10" x 2" LDW B4E-Heavy CSK	630	TR
1	Door Position Switch	9540	BLACK	RC
1	Power Transfer	EPT-12C		PR
1	Wiring Diagram	WIRING DIAGRAM FURNISHED BY HWDE. SUPPLIER		BY
1	Card Reader	CARD READER SUPPLIED UNDER DIVISION 28		BY
1	Power Supply	RPSMLR2BB		PR
1	Harness	WH-6E		ST
1	Harness	WH-192P		ST
1	Harness	WH-XXP (Length as REQ'D)		ST
1	Gasketing	700 EN @ Head & Jambs		NA
1	Door Sweep	C699A		NA
1	Threshold	896 S 1/4-20 SSMS/EA SIA	AL	NA

NOTE: Verify Door B000 to be Ballistic opening. Coordinate door hardware with ballistic door and frame manufacturer. Provide correct fasteners and all required brackets and plates for proper installation of door hardware. Operation: Door normally closed and locked. Presentation of valid credential retracts exit device latchbolt allowing entry. Free egress at all times. Mechanical key by-pass. TS switch to act as Request to exit. Coordinate wiring / installation with GC / EC / Security Vendor.

Set #094 - Exterior Ballistic - Card Access

Doors: B042B, B043B

1	Continuous Hinge	662HD UL EPT Prep	AL	ST
1	Electromechanical Lock	45HW-7DEU14R PATD C RQE	626	BE
1	Closer	TS93 SPT	689	DM
1	Kick Plate	K0050 10" x 2" LDW B4E-Heavy CSK	630	TR
1	Door Position Switch	9540	BLACK	RC
1	Power Transfer	EPT-12C		PR
1	Wiring Diagram	WIRING DIAGRAM FURNISHED BY HWDE. SUPPLIER		BY
1	Card Reader	CARD READER SUPPLIED UNDER DIVISION 28		BY
1	Power Supply	POWER SUPPLY SUPPLIED UNDER DIVISION 28		BY
1	Harness	WH-6E		ST
1	Harness	WH-192P		ST
1	Harness	WH-XXP (Length as REQ'D)		ST
1	Drip Cap	16 A - 4" ODW		NA
1	Gasketing	700 EN @ Head & Jambs		NA
1	Door Sweep	C699A		NA
1	Threshold	896 S 1/4-20 SSMS/EA SIA	AL	NA

NOTE: Coordinate door hardware with ballistic door and frame manufacturer. Provide correct fasteners and all required brackets and plates for proper installation of door hardware. Operation: Door normally closed and locked. Presentation of valid credential releases secure lever allowing entry. Free egress at all times. Mechanical key by-pass. Lockset is Fail-Secure- Upon loss of power door remains secure. Coordinate wiring / installation with GC / EC / Security Vendor.

Set #095 - Exterior Ballistic - Card Access

Doors: B029B

Set #095 - Exterior Ballistic - Card Access

1	Continuous Hinge	662HD UL EPT Prep	AL	ST
1	Exit Device	C LS MLR TS 2103 X 4903D LD	630	PR
1	Rim Cylinder	12E-72 PATD	626	BE
1	Closer	TS93 SPT	689	DM
1	Kick Plate	K0050 10" x 2" LDW B4E-Heavy CSK	630	TR
1	Door Position Switch	9540	BLACK	RC
1	Power Transfer	EPT-12C		PR
1	Wiring Diagram	WIRING DIAGRAM FURNISHED BY HWDE. SUPPLIER		BY
1	Card Reader	CARD READER SUPPLIED UNDER DIVISION 28		BY
1	Remote Release	REMOTE RELEASE SUPPLIED UNDER DIVISION 28		BY
1	Power Supply	RPSMLR2BB		PR
1	Harness	WH-6E		ST
1	Harness	WH-192P		ST
1	Harness	WH-XXP (Length as REQ'D)		ST
1	Drip Cap	16 A - 4" ODW		NA
1	Gasketing	700 EN @ Head & Jambs		NA
1	Door Sweep	C699A		NA
1	Threshold	896 S 1/4-20 SSMS/EA SIA	AL	NA

NOTE: Coordinate door hardware with ballistic door and frame manufacturer. Provide correct fasteners and all required brackets and plates for proper installation of door hardware.
Operation: Door normally closed and locked. Presentation of valid credential or Remote Release retracts exit device latchbolt allowing entry. Free egress at all times. Mechanical key by-pass. TS switch to act as Request to exit. Coordinate wiring / installation with GC / EC / Security Vendor.

Set #096 - Water, Fire Pump

Doors: B043A

4	Butt Hinge	FBB179 4.5" x 4.5"	26D	ST
1	Storeroom Lockset	45H-7D14R PATD	626	BE
1	Closer	8916 IS	606	DM
1	Kick Plate	K0050 10" x 2" LDW B4E-Heavy CSK	606	TR
1	Gasketing	2525C @ Head & Jambs		NA

Set #097 - Toilet

Doors: B039

3	Butt Hinge	FBB179 4.5" x 4.5"	26D	ST
1	Privacy Set	45H-0LT14R VIB	626	BE
1	Closer	8916 S-DS	606	DM
1	Kick Plate	K0050 10" x 2" LDW B4E-Heavy CSK	630	TR
1	Gasketing	2525 C @ Head & Jambs		NA

Set #098 - Stair

Doors: ST04

Set #098 - Stair

1	Continuous Hinge	662HD UL	AL	ST
1	Fire Exit Device	FL 2114 X 4914D	630	PR
1	Rim Cylinder	12E-72 PATD	626	BE
1	Closer	TS93 PT	689	DM
1	Kick Plate	K0050 10" x 2" LDW B4E-Heavy CSK	630	TR
1	Wall Bumper	1270CX	626	TR
1	Gasketing	2525C @ Head & Jambs		NA

Set #099 - IT - Card Access

Doors: B028

3	Butt Hinge	FBB179 4.5" x 4.5"	26D	ST
1	Elec Lockset	45HW-7DEU14R PATD C RQE	626	BE
1	Closer	8916 AF89	689	DM
1	Kick Plate	K0050 10" x 2" LDW B4E-Heavy CSK	630	TR
1	Wall Bumper	1270CX	626	TR
1	Door Position Switch	9540	BLACK	RC
1	Power Transfer	EPT-12C		PR
1	Wiring Diagram	WIRING DIAGRAM FURNISHED BY HWDE. SUPPLIER		BY
1	Card Reader	CARD READER SUPPLIED UNDER DIVISION 28		BY
1	Harness	WH-6E		ST
1	Harness	WH-192P		ST
1	Harness	WH-XXP (Length as REQ'D)		ST
1	Power Supply	POWER SUPPLY SUPPLIED UNDER DIVISION 28		BY
3	Silencer	1229A	GREY	TR

NOTE: Operation: Door normally closed and locked. Presentation of valid credential releases secure lever allowing entry. Free egress at all times. Mechanical key by-pass. Lockset is Fail-Secure-Upon loss of power door remains secure. Coordinate wiring / installation with GC / EC / Security Vendor.

Set #100 - Emerg Power - Card Access

Doors: B027B

Set #100 - Emerg Power - Card Access

3	Butt Hinge	FBB179 4.5" x 4.5" NRP	26D	ST
1	Exit Device	C FL MLR TS 2103 X 4903D	630	PR
1	Rim Cylinder	12E-72 PATD	626	BE
1	Closer	8916 DS	689	DM
1	Kick Plate	K0050 10" x 2" LDW B4E-Heavy CSK	630	TR
1	Door Position Switch	9540	BLACK	RC
1	Power Transfer	EPT-12C		PR
1	Wiring Diagram	WIRING DIAGRAM FURNISHED BY HWDE. SUPPLIER		BY
1	Card Reader	CARD READER SUPPLIED UNDER DIVISION 28		BY
1	Power Supply	RPSMLR2BB		PR
1	Harness	WH-6E		ST
1	Harness	WH-192P		ST
1	Harness	WH-XXP (Length as REQ'D)		ST
1	Gasketing	2525C @ Head & Jambs		NA

NOTE: Operation: Door normally closed and locked. Presentation of valid credential retracts exit device latchbolt allowing entry. Free egress at all times. Mechanical key by-pass. TS switch to act as Request to exit. Coordinate wiring / installation with GC / EC / Security Vendor.

Set #101 - Main Elec

Doors: B025B

3	Butt Hinge	FBB179 4.5" x 4.5"	26D	ST
1	Passage Set	45H-0N14R	626	BE
1	Closer	8916 SPA	689	DM
1	Kick Plate	K0050 10" x 2" LDW B4E-Heavy CSK	630	TR
1	Wall Bumper	1270CX	626	TR
1	Gasketing	2525 C @ Head & Jambs		NA

Set #102 - Emerg Power - Card Access

Doors: B026

3	Butt Hinge	FBB179 4.5" x 4.5" NRP	26D	ST
1	Exit Device	FL 2103 X 4903D	630	PR
1	Rim Cylinder	12E-72 PATD	626	BE
1	Closer	8916 SPA	689	DM
1	Kick Plate	K0050 10" x 2" LDW B4E-Heavy CSK	630	TR
1	Wall Bumper	1270CX	626	TR
1	Gasketing	2525C @ Head & Jambs		NA

Set #103 - Storage

Doors: B021

Set #103 - Storage

4	Butt Hinge	FBB179 4.5" x 4.5" NRP	26D	ST
1	Storeroom Lockset	45H-7D14R PATD	626	BE
1	Closer	8916 S-DS	606	DM
1	Kick Plate	K0050 10" x 2" LDW B4E-Heavy CSK	630	TR
1	Wall Bumper	1270CX	626	TR
3	Silencer	1229A	GREY	TR

Set #104 - Storage - Card Access

Doors: B024

8	Butt Hinge	FBB179 4.5" x 4.5" NRP	26D	ST
2	Manual Flushbolt	3917- Length as Req'd	626	TR
1	Electromechanical Lock	45HW-7DEU14R PATD 7/8"LTC C RQE	626	BE
1	Closer	8916 S-DS	689	DM
2	Kick Plate	K0050 10" x 1" LDW B4E-Heavy CSK	630	TR
1	Wall Bumper	1270CX	626	TR
1	Wiring Diagram	WIRING DIAGRAM FURNISHED BY HWDE. SUPPLIER		BY
1	Card Reader	CARD READER SUPPLIED UNDER DIVISION 28		BY
1	Harness	WH-6E		ST
1	Harness	WH-192P		ST
1	Harness	WH-XXP (Length as REQ'D)		ST
2	Door Position Switch	9540	BLACK	RC
1	Power Supply	POWER SUPPLY SUPPLIED UNDER DIVISION 28		BY
1	Dust Proof Strike	3910	626	TR
1	Gasketing	2525 C @ Head & Jambs		NA
1	Meeting Stile Seal	5070 CL		NA

NOTE: Doors normally closed and locked. Presentation of valid credential releases secure lever allowing entry. Free egress at all times. Mechanical key by-pass. Lockset is Fail-Secure-Upon loss of power door remains secure. Coordinate wiring / installation with GC / EC / Security Vendor.

Set #105 - Emerg Power - Card Access

Doors: B025A, B027A

Set #105 - Emerg Power - Card Access

8	Butt Hinge	FBB179 4.5" x 4.5" NRP	26D	ST
1	Exit Device	C FL TS 2201 LBR	630	PR
1	Exit Device	C FL MLR TS 2203 X 4903D LBR	630	PR
1	Rim Cylinder	12E-72 PATD	626	BE
2	Closer	8916 S-DS	689	DM
2	Door Position Switch	9540	BLACK	RC
2	Power Transfer	EPT-12C		PR
1	Wiring Diagram	WIRING DIAGRAM FURNISHED BY HWDE. SUPPLIER		BY
1	Card Reader	CARD READER SUPPLIED UNDER DIVISION 28		BY
1	Power Supply	RPSMLR2BB		PR
2	Harness	WH-6E		ST
2	Harness	WH-192P		ST
2	Harness	WH-XXP (Length as REQ'D)		ST
1	Meeting Stile Seal	5070 CL		NA
1	Gasketing	2525 C @ Head & Jambs		NA

NOTE: Operation: Doors closed and locked. Presentation of valid credential retracts active leaf latchbolt allowing authorized entry. Egress always allowed. TS switch to act as Request to Exit. Mechanical key override. All wiring and conduit by electrical contractor. Coordinate wiring and installation with EC / GC / Security Vendor.

Set #106 - Staff Entry - Card Access

Doors: B022A

3	Butt Hinge	FBB179 4.5" x 4.5"	26D	ST
1	Elec Lockset	45HW-7DEU14R PATD C RQE	626	BE
1	Closer	8916 AF89	689	DM
1	Kick Plate	K0050 10" x 2" LDW B4E-Heavy CSK	630	TR
1	Wall Bumper	1270CX	626	TR
1	Door Position Switch	9540	BLACK	RC
1	Power Transfer	EPT-12C		PR
1	Wiring Diagram	WIRING DIAGRAM FURNISHED BY HWDE. SUPPLIER		BY
1	Card Reader	CARD READER SUPPLIED UNDER DIVISION 28		BY
1	Harness	WH-6E		ST
1	Harness	WH-192P		ST
1	Harness	WH-XXP (Length as REQ'D)		ST
1	Power Supply	POWER SUPPLY SUPPLIED UNDER DIVISION 28		BY
1	Gasketing	2525 C @ Head & Jambs		NA

NOTE: Operation: Door normally closed and locked. Presentation of valid credential releases secure lever allowing entry. Free egress at all times. Mechanical key by-pass. Lockset is Fail-Secure-Upon loss of power door remains secure. Coordinate wiring / installation with GC / EC / Security Vendor.

Set #107 - Maint Shop - Card Access

Doors: B023

8	Butt Hinge	FBB179 4.5" x 4.5" NRP	26D	ST
2	Manual Flushbolt	3917- Length as Req'd - Top Bolt	626	TR
1	Electromechanical Lock	45HW-7DEU14R PATD 7/8"LTC C RQE	626	BE
1	Closer	8916 SPA	689	DM
2	Kick Plate	K0050 10" x 1" LDW B4E-Heavy CSK	630	TR
1	Overhead Stop	9020 Series	US32D	AB
1	Wall Bumper	1270CX	626	TR
1	Wiring Diagram	WIRING DIAGRAM FURNISHED BY HWDE. SUPPLIER		BY
1	Card Reader	CARD READER SUPPLIED UNDER DIVISION 28		BY
1	Harness	WH-6E		ST
1	Harness	WH-192P		ST
1	Harness	WH-XXP (Length as REQ'D)		ST
2	Door Position Switch	9540	BLACK	RC
1	Power Supply	POWER SUPPLY SUPPLIED UNDER DIVISION 28		BY
1	Dust Proof Strike	3910	626	TR
1	Gasketing	2525 C @ Head & Jambs		NA
1	Meeting Stile Seal	5070 CL		NA

NOTE: Doors normally closed and locked. Presentation of valid credential releases secure lever allowing entry. Free egress at all times. Mechanical key by-pass. Lockset is Fail-Secure-Upon loss of power door remains secure. Coordinate wiring / installation with GC / EC / Security Vendor.

Set #108 - Staff Entry - Card Access

Doors: B005

3	Butt Hinge	FBB168 4.5" x 4.5" NRP	26D	ST
1	Exit Device	C FL MLR TS 2103 X 4903D	630	PR
1	Rim Cylinder	12E-72 PATD	626	BE
1	Closer	8916 SPA	689	DM
1	Kick Plate	K0050 10" x 2" LDW B4E-Heavy CSK	630	TR
1	Wall Bumper	1270CX	626	TR
1	Door Position Switch	9540	BLACK	RC
1	Power Transfer	EPT-12C		PR
1	Wiring Diagram	WIRING DIAGRAM FURNISHED BY HWDE. SUPPLIER		BY
1	Card Reader	CARD READER SUPPLIED UNDER DIVISION 28		BY
1	Power Supply	RPSMLR2BB		PR
1	Harness	WH-6E		ST
1	Harness	WH-192P		ST
1	Harness	WH-XXP (Length as REQ'D)		ST
1	Gasketing	2525C @ Head & Jambs		NA

Set #108 - Staff Entry - Card Access

NOTE: Operation: Door normally closed and locked. Presentation of valid credential retracts exit device latchbolt allowing entry. Free egress at all times. Mechanical key by-pass. TS switch to act as Request to exit. Coordinate wiring / installation with GC / EC / Security Vendor.

Set #109 - Maint Storage

Doors: B045, B048

1	Cylinder	1E / 12E as Req'd	626	BE

NOTE: Balance of hardware by Gate manufacturer.

Set #110 - Receiving - Card Access

Doors: B018A

3	Butt Hinge	FBB179 4.5" x 4.5" NRP	26D	ST
1	Exit Device	C FL MLR TS 2103 X 4903D	630	PR
1	Rim Cylinder	12E-72 PATD	626	BE
1	Closer	8916 SPA	689	DM
1	Kick Plate	K0050 10" x 2" LDW B4E-Heavy CSK	630	TR
1	Wall Bumper	1270CX	626	TR
1	Door Position Switch	9540	BLACK	RC
1	Power Transfer	EPT-12C		PR
1	Wiring Diagram	WIRING DIAGRAM FURNISHED BY HWDE. SUPPLIER		BY
1	Card Reader	CARD READER SUPPLIED UNDER DIVISION 28		BY
1	Power Supply	RPSMLR2BB		PR
1	Harness	WH-6E		ST
1	Harness	WH-192P		ST
1	Harness	WH-XXP (Length as REQ'D)		ST
1	Gasketing	2525C @ Head & Jambs		NA

NOTE: Operation: Door normally closed and locked. Presentation of valid credential retracts exit device latchbolt allowing entry. Free egress at all times. Mechanical key by-pass. TS switch to act as Request to exit. Coordinate wiring / installation with GC / EC / Security Vendor.

Set #111 - Corridor - Card Access

Doors: B029A

Set #111 - Corridor - Card Access

3	Butt Hinge	FBB179 4.5" x 4.5" NRP	26D	ST
1	Exit Device	C MLR TS 2103 X 4903D LD	630	PR
1	Rim Cylinder	12E-72 PATD	626	BE
1	Closer	8916 SPA	689	DM
1	Kick Plate	K0050 10" x 2" LDW B4E-Heavy CSK	630	TR
1	Door Position Switch	9540	BLACK	RC
1	Power Transfer	EPT-12C		PR
1	Wiring Diagram	WIRING DIAGRAM FURNISHED BY HWDE. SUPPLIER		BY
1	Card Reader	CARD READER SUPPLIED UNDER DIVISION 28		BY
1	Power Supply	RPSMLR2BB		PR
1	Harness	WH-6E		ST
1	Harness	WH-192P		ST
1	Harness	WH-XXP (Length as REQ'D)		ST
1	Wall Bumper	1270CX	626	TR
3	Silencer	1229A	GREY	TR

Set #112 - Maint Shop - Card Access

Doors: B020

8	Butt Hinge	FBB179 4.5" x 4.5"	26D	ST
2	Manual Flushbolt	3917- Length as Req'd - Top Bolt	626	TR
1	Electromechanical Lock	45HW-7DEU14R PATD 7/8"LTC C RQE	626	BE
1	Closer	8916 IS	689	DM
2	Kick Plate	K0050 10" x 1" LDW B4E-Heavy CSK	630	TR
1	Wall Bumper	1270CX	626	TR
1	Wiring Diagram	WIRING DIAGRAM FURNISHED BY HWDE. SUPPLIER		BY
1	Card Reader	CARD READER SUPPLIED UNDER DIVISION 28		BY
1	Harness	WH-6E		ST
1	Harness	WH-192P		ST
1	Harness	WH-XXP (Length as REQ'D)		ST
1	Power Supply	POWER SUPPLY SUPPLIED UNDER DIVISION 28		BY
1	Dust Proof Strike	3910	626	TR
1	Meeting Stile Seal	5070 CL		NA
2	Door Position Switch	9540	BLACK	RC
2	Silencer	1229A	GREY	TR

NOTE: Doors normally closed and locked. Presentation of valid credential releases secure lever allowing entry. Free egress at all times. Mechanical key by-pass. Lockset is Fail-Secure-Upon loss of power door remains secure. Coordinate wiring / installation with GC / EC / Security Vendor.

Set #113 - Mail Room - Card Access

Doors: B019

Set #113 - Mail Room - Card Access

8	Butt Hinge	FBB179 4.5" x 4.5" NRP	26D	ST
2	Manual Flushbolt	3917- Length as Req'd - Top Bolt	626	TR
1	Electromechanical Lock	45HW-7DEU14R PATD 7/8"LTC C RQE	626	BE
1	Closer	8916 S-DST	689	DM
2	Kick Plate	K0050 10" x 1" LDW B4E-Heavy CSK	630	TR
1	Wall Bumper	1270CX	626	TR
1	Wiring Diagram	WIRING DIAGRAM FURNISHED BY HWDE. SUPPLIER		BY
1	Card Reader	CARD READER SUPPLIED UNDER DIVISION 28		BY
1	Harness	WH-6E		ST
1	Harness	WH-192P		ST
1	Harness	WH-XXP (Length as REQ'D)		ST
1	Power Supply	POWER SUPPLY SUPPLIED UNDER DIVISION 28		BY
1	Dust Proof Strike	3910	626	TR
1	Meeting Stile Seal	5070 CL		NA
2	Door Position Switch	9540	BLACK	RC
2	Silencer	1229A	GREY	TR

NOTE: Doors normally closed and locked. Presentation of valid credential releases secure lever allowing entry. Free egress at all times. Mechanical key by-pass. Lockset is Fail-Secure-Upon loss of power door remains secure. Coordinate wiring / installation with GC / EC / Security Vendor.

Set #114 - Exterior Utility Yard - Card Access

Doors: B051

1	Continuous Hinge	662HD UL EPT Prep	AL	ST
1	Exit Device	C LS MLR TS 2103 X 4903D	630	PR
1	Rim Cylinder	12E-72 PATD	606	BE
1	Closer	TS93 SPT	689	DM
1	Kick Plate	K0050 10" x 2" LDW B4E-Heavy CSK	630	TR
1	Door Position Switch	9540	BLACK	RC
1	Power Transfer	EPT-12C		PR
1	Wiring Diagram	WIRING DIAGRAM FURNISHED BY HWDE. SUPPLIER		BY
1	Card Reader	CARD READER SUPPLIED UNDER DIVISION 28		BY
1	Power Supply	RPSMLR2BB		PR
1	Harness	WH-XXP (Length as REQ'D)		ST
1	Harness	WH-6E		ST
1	Harness	WH-192P		ST
1	Drip Cap	16 A - 4" ODW		NA
1	Gasketing	700 EN @ Head & Jambs		NA
1	Door Sweep	C699A		NA
1	Saddle Threshold	425 HD 1/4-20 SSMS/EA SIA	AL	NA

Set #114 - Exterior Utility Yard - Card Access

NOTE: Operation: Door normally closed and locked. Presentation of valid credential retracts exit device latchbolt allowing entry. Free egress at all times. Mechanical key by-pass. TS switch to act as Request to exit. Coordinate wiring / installation with GC / EC / Security Vendor. Do not notch perimeter seal, adjust exit device and door closer mounting dimensions.

Set #115 - Exterior Utility Yard - Card Access

Doors: B052A, B052B

2	Continuous Hinge	662HD UL EPT Prep	AL	ST
1	Removable Mullion	KR822 MCS	689	PR
1	Exit Device	C LS MLR TS 2103 X 4903D	630	PR
1	Exit Device	C LS TS 2101 LD	630	PR
2	Rim Cylinder	12E-72 PATD	606	BE
2	Closer	TS93 SPT	689	DM
2	Kick Plate	K0050 10" x 2" LDW B4E-Heavy CSK	630	TR
2	Door Position Switch	9540	BLACK	RC
2	Power Transfer	EPT-12C		PR
1	Wiring Diagram	WIRING DIAGRAM FURNISHED BY HWDE. SUPPLIER		BY
1	Card Reader	CARD READER SUPPLIED UNDER DIVISION 28		BY
1	Power Supply	RPSMLR2BB		PR
2	Harness	WH-XXP (Length as REQ'D)		ST
2	Harness	WH-6E		ST
2	Harness	WH-192P		ST
1	Drip Cap	16 A - 4" ODW		NA
1	Gasketing	700 EN @ Head & Jambs		NA
2	Door Sweep	C699A		NA
1	Saddle Threshold	425 HD 1/4-20 SSMS/EA SIA	AL	NA

NOTE: Operation: Doors normally closed and locked. Presentation of valid credential retracts exit device latchbolt of active leaf allowing entry. Free egress at all times. Mechanical key by-pass. TS switch to act as Request to exit. Coordinate wiring / installation with GC / EC / Security Vendor. Do not notch perimeter seal, adjust exit device and door closer mounting dimensions.

Set #116 - Stair - Card Access - Fail Safe

Doors: ST64

Set #116 - Stair - Card Access - Fail Safe

1	Continuous Hinge	662HD UL EPT Prep	AL	ST
1	Exit Device	C FL TS E2103 X 4908D FS	630	PR
1	Rim Cylinder	12E-72 PATD	626	BE
1	Mortise Cylinder	1E-74 PATD	626	BE
1	Closer	TS93 T	689	DM
1	Kick Plate	K0050 10" x 2" LDW B4E-Heavy CSK	630	TR
1	Wall Bumper	1270CX	626	TR
1	Door Position Switch	9540	BLACK	RC
1	Power Transfer	EPT-12C		PR
1	Wiring Diagram	WIRING DIAGRAM FURNISHED BY HWDE. SUPPLIER		BY
1	Card Reader	CARD READER SUPPLIED UNDER DIVISION 28		BY
1	Power Supply	POWER SUPPLY SUPPLIED UNDER DIVISION 28		BY
1	Harness	WH-XXP (Length as REQ'D)		ST
1	Harness	WH-6E		ST
1	Harness	WH-192P		ST
1	Gasketing	2525C @ Head & Jambs		NA

NOTE: Operation: Door is normally closed and locked. Presenting valid credential to card reader releases secure lever allowing entry. Mechanical key override. In the event of power loss or activation of building fire alarm system, electrified trim of exit device to unlock allowing entry. TS switch to act as Request to Exit. Coordinate wiring / installation with GC / EC / Security Vendor.

Set #117 - Stair - Card Access - Fail Safe

Doors: ST63

1	Continuous Hinge	662HD UL EPT Prep	AL	ST
1	Exit Device	C FL TS E2103 X 4908D FS	630	PR
1	Rim Cylinder	12E-72 PATD	626	BE
1	Mortise Cylinder	1E-74 PATD	626	BE
1	Closer	8916 SPA	689	DM
1	Kick Plate	K0050 10" x 2" LDW B4E-Heavy CSK	630	TR
1	Wall Bumper	1270CX	626	TR
1	Door Position Switch	9540	BLACK	RC
1	Power Transfer	EPT-12C		PR
1	Wiring Diagram	WIRING DIAGRAM FURNISHED BY HWDE. SUPPLIER		BY
1	Card Reader	CARD READER SUPPLIED UNDER DIVISION 28		BY
1	Power Supply	POWER SUPPLY SUPPLIED UNDER DIVISION 28		BY
1	Harness	WH-XXP (Length as REQ'D)		ST
1	Harness	WH-6E		ST
1	Harness	WH-192P		ST
1	Gasketing	2525C @ Head & Jambs		NA

Set #117 - Stair - Card Access - Fail Safe

NOTE: Operation: Door is normally closed and locked. Presenting valid credential to card reader releases secure lever allowing entry. Mechanical key override. In the event of power loss or activation of building fire alarm system, electrified trim of exit device to unlock allowing entry. TS switch to act as Request to Exit. Coordinate wiring / installation with GC / EC / Security Vendor.

Set #118 - Mech Penthouse

Doors: 6001

8	Butt Hinge	FBB168 4.5" x 4.5"	4	ST
1	Auto Flush Bolt	3810 x 3810	626	TRIM
1	Passage Set	45H-0N14R 7/8"LTC	626	BE
1	Coordinator	3094B2	BLACK	TR
2	Closer	8916 S-DS	689	DM
2	Mounting Bracket	3095 / 3096 as Req'd	BLACK	TR
2	Kick Plate	K0050 10" x 1" LDW B4E-Heavy CSK	630	TR
1	Dust Proof Strike	3910	626	TR
1	Gasketing	2525 C @ Head & Jambs		NA
1	Meeting Stile Seal	5070 CL		NA

Set #119 - Roof - Card Access

Doors: 6002, 6005

1	Continuous Hinge	662HD UL EPT Prep	AL	ST
1	Elec Lockset	45HW-7DEU14R PATD C RQE	626	BE
1	Closer	TS93 SPT	689	DM
1	Kick Plate	K0050 10" x 2" LDW B4E-Heavy CSK	630	TR
1	Door Position Switch	9540	BLACK	RC
1	Power Transfer	EPT-12C		PR
1	Wiring Diagram	WIRING DIAGRAM FURNISHED BY HWDE. SUPPLIER		BY
1	Card Reader	CARD READER SUPPLIED UNDER DIVISION 28		BY
1	Harness	WH-6E		ST
1	Harness	WH-192P		ST
1	Harness	WH-XXP (Length as REQ'D)		ST
1	Power Supply	POWER SUPPLY SUPPLIED UNDER DIVISION 28		BY
1	Drip Cap	16 A - 4" ODW		NA
1	Gasketing	700 EN @ Head & Jambs		NA
1	Threshold	896 S 1/4-20 SSMS/EA SIA	AL	NA

NOTE: Operation: Door normally closed and locked. Presentation of valid credential releases secure lever allowing entry to roof. Free egress at all times. Mechanical key by-pass. Lockset is Fail-Secure-Upon loss of power door remains secure from inside. Coordinate wiring / installation with GC / EC / Security Vendor.

Opening List

Opening	Hdw Set	Opening Label	Door Type	Frame Type
3007	049			
4861	053			
B020	112			
1001C	003			
5202A	043			
1005	022			
1006	022			
1007	049			
1008	020			
1009	020			
1011	020			
1012	029			
1013	020			
1014	020			
1016	027			
1017	022			
1019	035			
1020	021			
1021	021			
1022	009			
1023	018			
1024	010			
1026	067			
1027	065			
1028	036A			
1100	073			
1103	013			
1104	022			
1110	011			
1111	011			
1113	012			
1200	008			
1202	076			
1301	068			
1302	064			
1303	011			
1304	025			
1307	016			
1308	016			
1309	024			
1310	024			
1311	036			
1400	072			

Opening	Hdw Set	Opening Label	Door Type	Frame Type
1401	038			
1402	036			
1403	065			
1404	016			
1405	016			
1406	025			
1407	006			
1408	016			
1409	016			
1410	016			
1411	016			
1412	016			
1413	080			
1415	059			
1416	036			
1417	078			
1418	078			
2005	022			
2006	022			
2007	049			
2008	020			
2009	020			
2011	020			
2012	029			
2013	020			
2014	020			
2016	028			
2017	022			
2018	049			
2019	035			
2020	021			
2021	021			
2022	068			
2026	075			
2100	071			
2101	059			
2102	016			
2103	016			
2105	024			
2108	059			
2109	016			
2110	016			
2111	016			
2112	026			
2113	016			
2115	016			

Opening	Hdw Set	Opening Label	Door Type	Frame Type
2116	016			
2117	016			
2120	020			
2121	026			
2122	016			
2123	069			
2124	058			
2200	062			
2201	026			
2202	026			
2203	026			
2204	026			
2205	067			
2206	016			
2207	016			
2208	016			
2210	016			
2211	016			
2215	026			
2221	020			
2300	073			
2301	065			
2305	071			
2306	063			
2307	059			
2308	061			
2309	064			
2310	059			
2311	016			
2312	016			
2313	016			
2314	016			
2316	016			
2319	052			
2320	016			
2400	064			
2401	060			
2402	060			
2405	016			
2406	016			
2407	016			
2409	074			
3005	022			
3006	022			
3008	020			
3011	020			

Opening	Hdw Set	Opening Label	Door Type	Frame Type
3012	029			
3013	020			
3014	020			
3016	027			
3017	022			
3018	050			
3019	035			
3020	021			
3021	021			
3022	020			
3023	020			
3101	032			
3102	016			
3103	016			
3104	016			
3105	031			
3106	018			
3107	016			
3108	016			
3111	032			
3112	016			
3113	016			
3114	031			
3115	018			
3116	016			
3117	016			
3118	016			
3119	025			
3122	032			
3123	016			
3124	016			
3125	031			
3126	018			
3127	016			
3128	016			
3129	016			
3133	016			
3134	018			
3135	016			
3137	016			
3138	019			
3139	019			
3140	016			
3143	016			
3144	016			
3145	016			

Opening	Hdw Set	Opening Label	Door Type	Frame Type
3146	016			
3147	016			
3149	016			
3150	016			
3151	016			
3152	016			
3154	016			
3156	016			
3157	016			
3158	016			
3159	016			
3160	016			
3161	016			
3162	017			
3165	017			
3166	016			
3167	016			
3169	016			
3170	016			
3171	016			
3173	026			
3174	026			
3175	025			
3176	017			
3177	018			
3179	032			
3180	016			
3181	016			
3182	018			
3183	031			
3184	016			
3185	016			
3186	016			
3189	032			
3190	024			
3191	016			
3192	016			
3193	016			
3194	031			
3195	018			
3196	016			
3197	016			
3200	032			
3201	016			
3202	016			
3203	016			

Opening	Hdw Set	Opening Label	Door Type	Frame Type
3204	031			
3205	018			
3206	016			
3207	016			
3211	016			
3212	019			
3213	018			
3214	016			
3215	016			
3216	018			
3217	016			
3218	024			
3301	016			
3302	016			
3303	016			
3304	016			
4005	022			
4006	022			
4007	049			
4011	020			
4012	029			
4013	020			
4016	028			
4017	022			
4018	049			
4019	035			
4020	021			
4021	021			
4022	020			
4023	020			
4025	055			
4101	033			
4102	016			
4103	016			
4104	016			
4105	031			
4106	018			
4107	016			
4108	016			
4110	032			
4111	016			
4112	016			
4113	031			
4114	018			
4115	016			
4116	016			

Opening	Hdw Set	Opening Label	Door Type	Frame Type
4117	016			
4118	036			
4121	032			
4122	016			
4123	016			
4124	031			
4125	018			
4126	016			
4127	016			
4128	016			
4132	024			
4133	024			
4134	022			
4135	039			
4138	032			
4139	016			
4140	016			
4141	018			
4142	031			
4143	016			
4144	016			
4145	016			
4148	032			
4149	036			
4150	016			
4151	016			
4152	016			
4153	031			
4154	018			
4155	016			
4156	016			
4159	032			
4160	020			
4161	016			
4162	016			
4163	016			
4164	031			
4165	018			
4166	016			
4167	016			
4169	037			
4170	038			
4171	038A			
4214	046			
4215	047			
4862	053			

Opening	Hdw Set	Opening Label	Door Type	Frame Type
5000	048			
5005	022			
5007	049			
5008	045			
5010	020			
5012	029			
5013	020			
5014	020			
5016	027			
5017	022			
5018	049			
5019	035			
5020	021			
5021	021			
5022	020			
5023	020			
5024	056			
5026	056			
5027	036			
5101	033			
5102	026			
5103	016			
5104	016			
5106	018			
5107	031			
5108	016			
5109	016			
5111	032			
5112	026			
5113	016			
5114	031			
5115	018			
5117	016			
5118	016			
5121	033			
5122	026			
5123	016			
5124	031			
5125	018			
5127	016			
5128	016			
5135	018			
5136	024			
5137	036			
5138	036			
5140	033			

Opening	Hdw Set	Opening Label	Door Type	Frame Type
5141	016			
5142	016			
5143	031			
5144	018			
5146	016			
5147	026			
5150	033			
5151	016			
5152	016			
5154	031			
5155	018			
5156	016			
5157	026			
5160	033			
5161	016			
5162	016			
5163	016			
5165	031			
5166	018			
5167	016			
5168	026			
5169	034			
5170	033			
5171	016			
5173	019			
5174	030			
5175	026			
5176	016			
5200	015			
5201	044			
5203	054			
5204	020			
5205	038			
5300	033			
5301	016			
5302	016			
5303	016			
5305	024			
5306	016			
5307	016			
5308	016			
5400	016			
6001	118			
6002	119			
6003	022			
6005	119			

Opening	Hdw Set	Opening Label	Door Type	Frame Type
B000	093			
B002	083			
B003	081			
B004	082			
B005	108			
B006	084			
B007	085			
B008	020			
B010	020			
B011	020			
B012	087			
B013	020			
B014	087			
B015	088			
B017	093			
B018	090			
B019	113			
B021	103			
B023	107			
B024	104			
B026	102			
B028	099			
B030	072			
B031	026			
B032	015			
B033	015			
B034	036			
B038	025			
B039	097			
B040	093			
B041	093			
B045	109			
B046	036			
B048	109			
B049	036			
B050	086			
B051	114			
ST03	089			
ST04	098			
ST12	005			
ST13	023			
ST14	023			
ST21	049			
ST22	023			
ST23	023			
ST24	023			

Opening	Hdw Set	Opening Label	Door Type	Frame Type
ST31	049			
ST32	023			
ST33	023			
ST34	023			
ST41	049			
ST42	023			
ST43	023			
ST44	023			
ST51	049			
ST52	023			
ST53	023			
ST54	023			
ST63	117			
ST64	116			
1001A	001			
1001B	002			
1001D	004			
1002A	007			
1002B	006			
1018A	049			
1018B	073			
1025A	067			
1025B	077			
1300A	079			
1300B	072			
2009A	065			
2025A	066			
2025B	064			
2025C	066			
2106A	024			
2106B	070			
2213A	026			
2213B	039			
2214A	026			
2214B	039			
2304A	061			
2304B	060			
2305B	034			
2306B	034			
4024A	056			
4026A	056			
4026B	054			
4172A	038			
4172B	038			
4200A	048			
4201A	047			

Opening	Hdw Set	Opening Label	Door Type	Frame Type
4202A	051			
4202B	052			
4203A	051			
4203B	052			
4210A	047			
4210B	053			
4210C	053			
4210D	054			
4211A	046			
4215B	053			
4215C	053			
5105A	016			
5105B	014			
5116A	016			
5116B	014			
5126A	016			
5126B	014			
5129A	022			
5129B	014			
5129C	022			
5133A	039			
5133B	039			
5145A	016			
5145B	014			
5153A	016			
5153B	014			
5164A	016			
5164B	014			
5172A	016			
5172B	014			
5202B	042			
5202C	040			
5202D	041			
B001A	091			
B001B	091			
B001C	092			
B018A	110			
B018B	092			
B022A	106			
B022B	093			
B022C	092			
B025A	105			
B025B	101			
B027A	105			
B027B	100			
B029A	111			

Opening	Hdw Set	Opening Label	Door Type	Frame Type
B029B	095			
B042A	078			
B042B	094			
B043A	096			
B043B	094			
B052A	115			
B052B	115			
ST11A	049			
ST11B	023			
3024A / B	057			

SECTION 08 71 13 - POWER DOOR OPERATORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Power door operators for swinging doors.

B. Related Requirements:
1. Section 08 42 29.33 "Swinging Automatic Entrances" for swinging doors and frames packaged with power door operators.

1.2 DEFINITIONS

A. AAADM: American Association of Automatic Door Manufacturers.

B. Activation Device: A control that, when actuated, sends an electrical signal to the door operator to open the door.

C. For automatic door terminology, see BHMA A156.10 for definitions of terms.

1.3 COORDINATION

A. Templates: Distribute for doors, frames, and other work specified to be factory prepared and reinforced for installing power door operators.

B. Coordinate hardware for doors with operators to ensure proper size, thickness, hand, function, and finish.

C. Electrical System Roughing-in: Coordinate layout and installation of power door operators with connections to the following:

1. Power supplies.
2. Access-control system.
3. Remote activation devices.
4. Remote monitoring systems.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for power door operators.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: For power door operators.

1. Include plans, elevations, sections, hardware mounting heights, and attachment details.
2. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Indicate locations of activation and safety devices.
4. Include diagrams for power, signal, and control wiring.

C. Samples: For each exposed product and for each color and texture specified.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Certificates: For each type of power door operator. For each operator for fire-rated door assemblies, certify that operator is listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction for use on types and sizes of labeled fire doors required.

C. Sample Warranties: For manufacturer's special warranties.

1.7 CLOSEOUT SUBMITTALS

A. Maintenance Data: For power door operators, safety devices, and control systems, to include in maintenance manuals.

1.8 QUALITY ASSURANCE

A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer for installation and maintenance of units required for this Project.

1. Maintenance Proximity: Not more than two hours' normal travel time from Installer's place of business to Project site.

1.9 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of power door operators that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Faulty or sporadic operation of power door operator, including controls.
b. Deterioration of metals, metal finishes, and other materials beyond normal weathering or use.

2. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain power door operators, including activation and safety devices, from same manufacturer as for hardware in Section 08 71 00 "Door Hardware."

2.2 POWER DOOR OPERATORS, GENERAL

A. General: Provide operators of size recommended by manufacturer for door size, weight, and movement; for condition of exposure; and for long-term, maintenance-free operation under normal traffic load for occupancy type indicated; and in accordance with UL 325. Coordinate operator mechanisms with door operation, hinges, and activation and safety devices.
1. Fire-Rated Doors: Provide door operators for fire-rated door assemblies that comply with NFPA 80 for fire-rated door components and are listed and labeled by a qualified testing agency.
2. Wind Load: Provide door operators on exterior doors that will open and close doors and maintain them in fully closed position when subjected to wind load.

B. Electromechanical Operating System: Self-contained unit powered by permanent-magnet dc motor; with closing speed controlled mechanically by gear train and dynamically by braking action of electric motor, connections for power and activation- and safety-device wiring, and manual operation, including spring closing when power is off.

1. Power Unit:

C. Hinges: See Section 08 71 00 "Door Hardware".

D. Housing for Overhead Concealed Operators: Fabricated from minimum 0.125-inch-thick, extruded or formed aluminum and extending full width of door opening, including door jambs, to conceal door operators and controls. Provide hinged or removable access panels for service and adjustment of door operators and controls. Secure panels to prevent unauthorized access.

E. Brackets and Reinforcements: Fabricated from aluminum with nonstaining, nonferrous shims for aligning system components.

F. Fire-Door Package: Consisting of UL-listed latch mechanism, power-reset box, and caution signage for fire-rated doors. Latch mechanism shall allow door to swing free during automatic operation; when fire is detected, latch actuator shall cause exit hardware to latch when door closes. Provide latch actuators with fail-secure design.

G. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.3 POWER DOOR OPERATORS FOR SWINGING DOORS

A. Standard: BHMA A156.10.

B. Performance Requirements:

1. Opening Force:

a. Power-Operated Doors: Not more than 50 lbf required to manually set door in motion if power fails; not more than 15 lbf required to open door to minimum required width.

C. Configuration: Operator to control single swinging door.

1. Traffic Pattern: One way.
2. Operator Mounting: Overhead concealed.

D. Operation: Power opening and spring closing. Provide time delay for door to remain open before initiating closing cycle as required by BHMA A156.10.

E. Operating System: Electromechanical.

F. Microprocessor Control Unit: Solid-state controller.

G. Manufacturers:: ASSA ABLOY Entrances Systems, LCN Closers or Nabco Entrance, Inc.

1. Operators shall be of heavy-duty construction. Sizes are to be determined by manufacturer's recommendations for door size and location.

a. Units shall operate as manual door closers unless operator is activated and when power is lost.

2. Operation: Pressing actuator switch automatically opens door leaf to 90-degrees, operator then manually closes door after variable time delay expires.
3. Actuators: Provide 4 1/2-inch square wall- and bollard-mounted, and 1 3/4-inch wide jamb-mounted stainless-steel actuator plates as indicated.

a. Wireless actuators shall operate at 900MHz, hardwired actuators shall operate on 24V provided by operator.
b. Engrave "PUSH TO OPEN" and the Universal Accessibility Symbol on plate; fill with blue enamel paint.

4. Control Unit:

a. Micro-processor controlled.
b. Provide adjustable opening speed, adjustable backcheck speed, adjustable closing speed, and adjustable hold-open period.
c. Provide built-in 3-position switch for "OFF", "ON" and "HOLD-OPEN" operation and to deactivate actuator switches.
d. Provide safety-stop feature: If object or obstruction is encountered during opening and/or closing cycles, door operator stops and slowly returns to closed or open position respectively.

e. Provide with safety circuit so that if actuator switch is activated when door is latched or locked, power operator resets without operator and/or door damage.

5. Accessories: Furnish complete with fastenings, fittings, and other accessories as required for a complete installation.
6. Manufacturer shall provide detailed wiring diagrams showing point-to-point hook-up of all components affected (e.g. operators, actuators, power, etc.).
7. Coordinate electrical connection and installation with Divisions 26 and 28.

H. Features:

1. Adjustable opening and closing speed.
2. Adjustable opening and closing force.
3. Adjustable backcheck.
4. Adjustable hold-open time from zero to 30 seconds.
5. Adjustable time delay.
6. Adjustable acceleration.
7. Adjustable limit switch.
8. Obstruction recycle.
9. Power door re-open if stopped while closing.
10. On-off/hold-open switch to control electric power to operator.

I. Controls: Activation and safety devices in accordance with BHMA standards.
1. Activation Device, Switch: Push-plate switch on each side of door to activate door operator.
2. Safety Device, Presence Sensor: Mounted on door header to detect pedestrians in presence zone and to prevent door from closing.

J. Exposed Finish: Baked-enamel or powder-coat finish. Finish matching door and frame.

1. Color: As selected by Architect from full range of industry colors and color densities.

2.4 MATERIALS

A. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.

1. Extrusions: ASTM B221.
2. Sheet: ASTM B209.

2.5 CONTROLS

A. General: Provide controls, including activation and safety devices, in accordance with BHMA standards; for condition of exposure; and for long-term, maintenance-free operation under normal traffic load for occupancy type indicated. Coordinate activation and safety devices with door operation and door operator mechanisms.

B. Presence Sensors: Self-contained, active-infrared scanner units; adjustable to provide detection field sizes and functions required by BHMA A156.10. Sensors shall remain active at all times.

C. Push-Plate Switch: Momentary-contact door control switch with flat push-plate actuator with contrasting-colored, engraved message.

1. Configuration:

    a. Round push plate with 4-by-4-inch junction box.

        1) Mounting: semiflush in wall.

2. Push-Plate Material: Stainless steel as selected by Architect from manufacturer's full range.
3. Message: International symbol of accessibility and "Push to Open."

2.6 BOLLARD PEDESTAL

A. Basis of Design

1. Model No: 8BOL-PRO-001-304

2. 56” Round 8” Diameter Pedestal with Tapered Top, customizable.

3. Material and Finish: Brushed #4 finish, #304 stainless,8”round bollard pedestal, .120” wall tube, tapered top, mounted from inside.

2.7 ACCESSORIES

A. Signage: As required by cited BHMA standard for type of door and its operation.

1. Application Process: Decals.

2.8 FABRICATION

A. Factory fabricate power door operators to comply with indicated standards.

B. Form aluminum shapes before finishing.

C. Fabricate exterior components to drain condensation and water-passing joints within operator enclosure to the exterior.

D. Use concealed fasteners to greatest extent possible. Where exposed fasteners are required, use countersunk Phillips flat-head machine screws, finished to match operator.

E. Provide metal cladding, completely covering visible surfaces before shipment to Project site. Fabricate cladding with concealed fasteners and connection devices, with accurately fitted joints with ends coped or mitered to produce hairline joints free of burrs and distortion, and with allowance for thermal expansion at exterior doors.

2.9 GENERAL FINISH REQUIREMENTS

A. Protect mechanical finishes on exposed surfaces from damage by applying strippable, temporary, protective covering before shipping.

B. Apply organic and anodic finishes to formed metal after fabrication unless otherwise indicated.

C. Appearance of Finished Work: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within range of approved Samples and are assembled or installed to minimize contrast.

2.10 ALUMINUM FINISHES

A. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of 1.5 mils. Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances, door and frame preparation and reinforcements, and other conditions affecting performance of power door operators.

B. Examine roughing-in for electrical systems to verify actual locations of power connections before power door operator installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Install power door operators in accordance with manufacturer's written instructions and cited BHMA standard for type of door operation and direction of pedestrian travel, including signage, controls, wiring, remote power units if any, and connection to building's power supply.

1. Do not install damaged components. Fit joints to produce hairline joints free of burrs and distortion.
2. Install operators true in alignment with established lines and door geometry without warp or rack. Anchor securely in place.

B. Controls: Install activation and safety devices in accordance with manufacturer's written instructions and cited BHMA standard for operator type and direction of pedestrian travel. Connect control wiring in accordance with Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."

C. Access-Control System: Connect operators to access-control system as specified in Section 28 15 00 "Access Control Hardware Devices."

D. Signage: Apply on both sides of each door as required by cited BHMA standard for type of door operator and direction of pedestrian travel.

3.3 FIELD QUALITY CONTROL

A. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. Test and inspect each power door operator installation, using AAADM inspection forms, to determine compliance of installed systems with applicable BHMA standards.

B. Power door operators will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

3.4 ADJUSTING

A. Adjust power door operators to function smoothly, and lubricate as recommended by manufacturer; comply with requirements of applicable BHMA standards.

1. Adjust operators on exterior doors for tight closure.

B. After completing installation of power door operators, inspect exposed finishes on doors and operators. Repair damaged finish to match original finish.

C. Readjust power door operators and controls after repeated operation of completed installation equivalent to three days' use by normal traffic (100 to 300 cycles).

D. Occupancy Adjustment: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

3.5 MAINTENANCE SERVICE

A. Initial Maintenance Service: Beginning at Substantial Completion, maintenance service shall include 12 months' full maintenance by skilled employees of power door operator Installer. Include monthly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper door operation. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.

1. Engage a Certified Inspector to perform safety inspection after each adjustment or repair and at end of maintenance period. Furnish completed inspection reports to Owner.
2. Perform maintenance during normal working hours.
3. Include 24-hour-per-day, seven-day-per-week, emergency callback service.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain power door operators.

END OF SECTION

SECTION 08 75 16 - WINDOW OPERATORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:

1. Motorized window actuators and controls as part of atrium smoke evacuation system.

B. Related Requirements:

1. Section 08 44 13 “Glazed Aluminum Curtain Walls” for windows in curtain walls operated by motorized window actuators.
2. Section 23 09 00 “Building Automation and Automatic Temperature Control Systems” for connection to Building Management System.
3. Section 28 46 00 “Addressable Fire Alarm System” for connection of window operator controllers to the fire alarm system.
4. Section 23 09 02 “Life Safety Systems.”
5. Section 23 09 03 and Section 28 46 10 “Smoke Management 23 09 03 and 28 46 10.”

1.2 COORDINATION

A. Coordinate work with glazed aluminum curtain wall operable units, building automation system, fire alarm system, life safety systems, and smoke management systems for a complete integrated system.

B. Electrical contractor to provide the following in conjunction with window operator installation:

1. Voltage drop calculation for wire runs to actuators to insure adequate power for synchronized operation of motors in each room.
2. Supply and installation of wiring (sized correctly for voltage drop), conduit, connectors, j-boxes, electrical enclosures, and required fuses.
3. Configure WCC Motor Control panel for correct motor lines, motor groups and outputs for fire life safety system feedback.

1.3 ACTION SUBMITTALS

A. Product Data: For each window actuator and controls type required.

1. Include manufacturer's standard details, fabrication methods, and mounting and installation recommendations for each component of the window operating system required.

B. Shop Drawings: For window acuators.

1. Include plans, elevations, sections, and attachment details for window actuators.

2. Include diagrams for power, signal, and control wiring between actuators and motor control panels.

1.4 INFORMATIONAL SUBMITTALS

A. Installation Instructions: Manufacturer's writing installation instructions for window actuators and motor control panels.

B. Qualification Data: For Manufacturer and Installer.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For window operators to include in maintenance manuals.

B. Special warranty.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: A window operator manufacturer with 5 years' experience in the manufacture of window operators and controllers for use in conjunction with life safety systems.

B. Installer Qualifications: Engage an experienced electrical installer who is an authorized representative for both installation and maintenance of units required.

C. UL Standard: Provide actuators and controls that are UL certified.

1.7 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of window operator system that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Capacity: Provide window actuators of size and force recommended by manufacturer for window size, weight, glass thickness, opening direction and movement.

2.2 MANUFACTURERS

A. Basis-of-Design Manufacturer: Subject to compliance with requirement, provide **WindowMaster Industries GmbH delivered by WindowMaster Clearline, Inc.** or manufacturer of a comparable product.

1. Manufacturer's Representative: Imola Frei; ifr.us@windomaster.com.

B. Source Limitations: Obtain window actuators and motor controllers from single source from single manufacturer.

2.3 MOTORIZED WINDOW ACTUATORS AND CONTROLS

A. Window Actuator: Programmable window actuators and control panels with intelligent "MotorLink" technology including the following capabilities:

1. Programmable for modification of tractive force and pressure for opening and closing.
2. Two-way communication with the control panel enabling feedback to the control software of the exact position of the window for precision of opening control and including security indicator for open windows.
3. Three speed operation including a slow speed in automatic mode, moderate speed when manually activated, and full speed in the event of an alarm.
4. Pressure Safety Function: Programmed safety function to monitor and reverse operation in case of detection of entrapped objects.
5. Fault Indication.
6. Synchronization Function: Capable of synchronizing operation of multiple devices on a single window with a tolerance of less than 0.08 inches.

B. Basis-of-Design Product: Subject to compliance with requirement, provide **Window Master; WMX/WMU Series Actuator with WCC Motor Control Panel** or comparable product.

1. Voltage Supply: 24v DC actuator with motor and all low voltage system components UL listed.
2. Open Circuit Voltage: 36 V DC maximum.
3. Actuator Maximum Stroke: 500 to 1000 mm.
4. Traction Force: 100 to 1500 N,
5. Power: 24W maximum.
6. Current Consumption: 0.5 to 5 amp per actuator.

C. Provide the number of actuators required based on window size, weight, glass thickness, window movement.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates areas and conditions, with Installer present, for compliance with requirements for substrate construction and other conditions affecting performance of the Work.

B. Examine locations of electrical connections.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Coordination: Furnish templates and diagrams as necessary for coordinating installation of window actuator and controls.

3.3 INSTALLATION

A. Install complete motorized window operating system according to manufacturer's written installation instructions and manuals, including controls, control wiring units, and cables.

3.4 ADJUSTING

A. Adjust window operators and controls to function smoothly and as intended including coordinated operation initiated by fire alarm system.

3.5 DEMONSTRATION

A. Engage a factory-authorized representative to train Owner's maintenance personnel to adjust, operate, and maintain window operators.

END OF SECTION

SECTION 08 80 00 - GLAZING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Glass products.
2. Laminated glass.
3. Insulating glass.
4. Glazing sealants.
5. Glazing tapes.
6. Miscellaneous glazing materials.

B. Related Requirements:

1. Section 057313 "Glazed Decorative Metal Railings" for glazing in railings.
2. Section 088113 "Decorative Glass Glazing."
3. Section 088300 "Mirrors."
4. Section 088853 "Security Glazing."

1.2 DEFINITIONS

A. Glass Manufacturers: Firms that produce primary glass, fabricated glass, or both, as defined in referenced glazing publications.

B. Glass Thicknesses: Indicated by thickness designations in millimeters in accordance with ASTM C1036.

C. IBC: International Building Code.

D. Interspace: Space between lites of an insulating-glass unit.

1.3 COORDINATION

A. Coordinate glazing channel dimensions to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances to achieve proper safety margins for glazing retention under each design load case, load case combination, and service condition.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:

1. Product Data: For sealants, indicating VOC content.
2. Laboratory Test Reports: For sealants, indicating compliance with requirements for low-emitting materials.

C. Glass Samples: For each type of glass product other than clear monolithic vision glass; 12 inches square.

D. Glazing Accessory Samples: For sealants and colored spacers, in 12-inch lengths. Install sealant Samples between two strips of material representative in color of adjoining framing system.

E. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings.

F. Delegated Design Submittal: For glass indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer and manufacturers of fabricated glass units.

B. Product Certificates: For glass.

C. Product Test Reports: For fabricated glass and glazing sealants, for tests performed by a qualified testing agency.

1. For glazing sealants, provide test reports based on testing current sealant formulations within previous 36-month period.

D. Sample Warranties: For special warranties.

1.6 QUALITY ASSURANCE

A. Fabricated-Glass Manufacturer Qualifications: A qualified manufacturer of fabricated glass units who is approved by primary glass manufacturer.

B. Installer Qualifications: A qualified glazing contractor for this Project who is certified under the North American Contractor Certification Program (NACC) for Architectural Glass & Metal (AG&M) contractors and who employs glazing technicians certified under the Architectural Glass and Metal Technician (AGMT) certification program.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Protect glazing materials in accordance with manufacturer's written instructions. Prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.

B. Comply with insulating-glass manufacturer's written instructions for venting and sealing units to avoid hermetic seal ruptures due to altitude change, if applicable.

1.8 FIELD CONDITIONS

A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.

1. Do not install glazing sealants when ambient and substrate temperature conditions are outside limits permitted by sealant manufacturer or are below 40 deg F.

1.9 WARRANTY

A. Manufacturer's Special Warranty for Coated-Glass Products: Manufacturer agrees to replace coated-glass units that deteriorate within specified warranty period. Deterioration of coated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning coated glass contrary to manufacturer's written instructions. Defects include peeling, cracking, and other indications of deterioration in coating.

1. Warranty Period: 10 years from date of Substantial Completion.

B. Manufacturer's Special Warranty for Laminated Glass: Manufacturer agrees to replace laminated-glass units that deteriorate within specified warranty period. Deterioration of laminated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning laminated glass contrary to manufacturer's written instructions. Defects include edge separation, delamination materially obstructing vision through glass, and blemishes exceeding those allowed by referenced laminated-glass standard.

1. Warranty Period: Five years from date of Substantial Completion.

C. Manufacturer's Special Warranty for Insulating Glass: Manufacturer agrees to replace insulating-glass units that deteriorate within specified warranty period. Deterioration of insulating glass is defined as failure of hermetic seal under normal use that is not attributed to glass breakage or to maintaining and cleaning insulating glass contrary to manufacturer's written instructions. Evidence of failure is obstruction of vision by dust, moisture, or film on interior surfaces of glass.

1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations for Glass: Obtain coated glass from single source from single manufacturer.

B. Source Limitations for Glazing Accessories: For each product and installation method, obtain from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. General: Installed glazing systems shall withstand normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to defective manufacture, fabrication, or installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.

B. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design glazing.

C. Structural Performance: Glazing shall withstand the following design loads within limits and under conditions indicated determined in accordance with the IBC and ASTM E1300:

1. Design Wind Pressures: As indicated on Drawings.
2. Design Snow Loads: As indicated on Drawings.
3. Probability of Breakage for Sloped Glazing: For glass sloped more than 15 degrees from vertical, design glass for a probability of breakage not greater than 0.001.
4. Maximum Lateral Deflection: For glass supported on all four edges, limit center-of-glass deflection at design wind pressure to not more than 1/50 times the short-side length or 1 inch, whichever is less.
5. Thermal Loads: Design glazing to resist thermal stress breakage induced by differential temperature conditions and limited air circulation within individual glass lites and insulated glazing units.

D. Safety Glazing: Where safety glazing is indicated, provide glazing that complies with 16 CFR 1201, Category II.

E. Thermal and Optical Performance Properties: Provide glass with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below:

1. For monolithic-glass lites, properties are based on units with lites 6 mm thick.
2. For laminated-glass lites, properties are based on products of construction indicated.
3. For insulating-glass units, properties are based on units of thickness indicated for overall unit and for each lite.
4. U-Factors: Center-of-glazing values, in accordance with NFRC 100 and based on most current non-beta version of LBL's WINDOW computer program, expressed as Btu/sq. ft. x h x deg F.
5. SHGC and Visible Transmittance: Center-of-glazing values, in accordance with NFRC 200 and based on most current non-beta version of LBL's WINDOW computer program.
6. Visible Reflectance: Center-of-glazing values, in accordance with NFRC 300.

2.3 GLASS PRODUCTS, GENERAL

A. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below unless more stringent requirements are indicated. See these publications for glazing terms not otherwise defined in this Section or in referenced standards.

1. NGA Publications: "Laminated Glazing Reference Manual" and "Glazing Manual."
2. AAMA Publications: AAMA GDSG-1, "Glass Design for Sloped Glazing," and AAMA TIR A7, "Sloped Glazing Guidelines."

3. IGMA Publication for Sloped Glazing: IGMA TB-3001, "Guidelines for Sloped Glazing."
4. IGMA Publication for Insulating Glass: SIGMA TM-3000, "North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use."

B. Safety Glazing Labeling: Where safety glazing is indicated, permanently mark glazing with certification label of the SGCC or another certification agency acceptable to authorities having jurisdiction. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.

C. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of the IGCC.

D. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass that complies with performance requirements and is not less than thickness indicated.

1. Minimum Glass Thickness for Exterior Lites: 6 mm.

E. Strength: Where annealed float glass is indicated, provide annealed float glass, heat-strengthened float glass, or fully tempered float glass as needed to comply with "Performance Requirements" Article. Where heat-strengthened float glass is indicated, provide heat-strengthened float glass or fully tempered float glass as needed to comply with "Performance Requirements" Article. Where fully tempered float glass is indicated, provide fully tempered float glass.

2.4 GLASS PRODUCTS

A. Clear Annealed Float Glass: ASTM C1036, Type I, Class 1 (clear), Quality-Q3.

B. Low-Iron Annealed Float Glass: ASTM C1036, Type I, Class I (clear), Quality-Q3; and with visible light transmission of not less than 91 percent and SHGC of not less than 0.87.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Guardian Glass LLC; Guardian UltraClear®.
b. Pilkington North America; NSG Group; Pilkington Optiwhite™ Low Iron.
c. Vitro Architectural Glass; Starphire.

C. Fully Tempered Float Glass: ASTM C1048, Kind FT (fully tempered), Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.

1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.

D. Heat-Strengthened Float Glass: ASTM C1048, Kind HS (heat strengthened), Type I, Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.

1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.

E. Ceramic-Coated Vision Glass: ASTM C1048, Condition C, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3; and complying with Specification No. 95-1-31 in NGA's "Engineering Standards Manual."

2.5 LAMINATED GLASS

A. Laminated Glass: ASTM C1172. Use materials that have a proven record of no tendency to bubble, discolor, or lose physical and mechanical properties after fabrication and installation.

1. Construction: Laminate glass with polyvinyl butyral interlayer to comply with interlayer manufacturer's written instructions.
2. Interlayer Thickness: Provide thickness not less than that indicated and as needed to comply with requirements.
3. Interlayer Color: Clear unless otherwise indicated.

2.6 INSULATING GLASS

A. Insulating-Glass Units: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, qualified in accordance with ASTM E2190.

1. Sealing System: Dual seal, with polyisobutylene and silicone primary and secondary sealants.
2. Perimeter Spacer: Warm edge spacer.

    a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to the following:

        1) Saint-Gobain Glass Corp; Ultimate.
        2) Technoform Glass Insulation North America; TGI-Spacer.
        3) Viracon: VTS.

3. Desiccant: Molecular sieve or silica gel, or a blend of both.

2.7 GLAZING SEALANTS

A. General:

1. Compatibility: Compatible with one another and with other materials they contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.
3. Verify sealant complies with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
4. Colors of Exposed Glazing Sealants: As selected by Architect from manufacturer's full range of industry colors.

B. Neutral-Curing Silicone Glazing Sealant, Class 50: Complying with ASTM C920, Type S, Grade NS, Use NT.

2.8 GLAZING TAPES

A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based, 100 percent solids elastomeric tape; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; and complying with ASTM C1281 and AAMA 800 for products indicated below:

1. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
2. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.

B. Expanded Cellular Glazing Tapes: Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces; and complying with AAMA 800 for the following types:

1. AAMA 810.1, Type 1, for glazing applications in which tape acts as primary sealant.
2. AAMA 810.1, Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.

2.9 MISCELLANEOUS GLAZING MATERIALS

A. General: Provide products of material, size, and shape complying with referenced glazing standard, recommended in writing by manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.

B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.

C. Setting Blocks:

1. Type recommended in writing by sealant or glass manufacturer.

D. Spacers:

1. Type recommended in writing by sealant or glass manufacturer.

E. Edge Blocks:

1. Type recommended in writing by sealant or glass manufacturer.

F. Cylindrical Glazing Sealant Backing: ASTM C1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.

2.10 FABRICATION OF GLAZING UNITS

A. Fabricate glazing units in sizes required to fit openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.

1. Allow for thermal movements from ambient and surface temperature changes acting on glass framing members and glazing components.

a. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

B. Clean-cut or flat-grind vertical edges of butt-glazed monolithic lites to produce square edges with slight chamfers at junctions of edges and faces.

C. Grind smooth and polish exposed glass edges and corners.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine framing, glazing channels, and stops, with Installer present, for compliance with the following:

1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
2. Presence and functioning of weep systems.
3. Minimum required face and edge clearances.
4. Effective sealing between joints of glass-framing members.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.

B. Examine glazing units to locate exterior and interior surfaces. Label or mark units as needed so that exterior and interior surfaces are readily identifiable. Do not use materials that leave visible marks in the completed Work.

3.3 GLAZING, GENERAL

A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.

B. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass includes glass with edge damage or other imperfections that, when installed, could weaken glass, impair performance, or impair appearance.

C. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.

D. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.

E. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.

F. Provide spacers for glass lites where length plus width is larger than 50 inches.

1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.
2. Provide 1/8-inch-minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.

G. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and in accordance with requirements in referenced glazing publications.

H. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.

I. Set glass lites with proper orientation so that coatings face exterior or interior as specified.

J. Where wedge-shaped gaskets are driven into one side of channel to pressurize sealant or gasket on opposite side, provide adequate anchorage so gasket cannot walk out when installation is subjected to movement.

K. Square cut wedge-shaped gaskets at corners and install gaskets in a manner recommended by gasket manufacturer to prevent corners from pulling away; seal corner joints and butt joints with sealant recommended in writing by gasket manufacturer.

3.4 TAPE GLAZING

A. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.

B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.

C. Cover vertical framing joints by applying tapes to heads and sills first, then to jambs. Cover horizontal framing joints by applying tapes to jambs, then to heads and sills.

D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.

E. Do not remove release paper from tape until right before each glazing unit is installed.

F. Center glass lites in openings on setting blocks, and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.

G. Apply cap bead of elastomeric sealant over exposed edge of tape.

3.5 GASKET GLAZING (DRY)

A. Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.

B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.

C. Installation with Drive-in Wedge Gaskets: Center glass lites in openings on setting blocks, and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended in writing by gasket manufacturer.

D. Installation with Pressure-Glazing Stops: Center glass lites in openings on setting blocks, and press firmly against soft compression gasket. Install dense compression gaskets and pressure-glazing stops, applying pressure uniformly to compression gaskets. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended in writing by gasket manufacturer.

E. Install gaskets so they protrude past face of glazing stops.

3.6 CLEANING AND PROTECTION

A. Immediately after installation, remove nonpermanent labels and clean surfaces.

B. Protect glass from contact with contaminating substances resulting from construction operations. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains.

1. If, despite such protection, contaminating substances do contact with glass, remove substances immediately as recommended in writing by glass manufacturer. Remove and replace glass that cannot be cleaned without damage to coatings.

C. Remove and replace glass that is damaged during construction period.

D. Wash glass on both exposed surfaces not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended in writing by glass manufacturer.

3.7 MONOLITHIC GLASS SCHEDULE

A. Clear Glass Type IGL-1: Annealed float glass.

1. Minimum Thickness: 6 mm.
2. Provide fully tempered safety glazing at locations indicated and where required to comply with applicable building codes, standards and regulations.

B. Clear Glass Type IGL-2: Fully tempered float glass.

1. Minimum Thickness: 12 mm.
2. Provide fully tempered safety glazing at locations indicated and where required to comply with applicable building codes, standards and regulations.

3.8 LAMINATED GLASS SCHEDULE

A. Clear Laminated Glass Type IGL-3: As specified in Section 05 73 13 “Glazed Decorative Metal Railings.”

3.9 INSULATING-LAMINATED-GLASS SCHEDULE

A. Low-E-Coated, Clear Insulating Laminated Glass Type GL-1 (typical):

1. Basis-of-Design Product: Vitro; Solarban 72 on Starphire.
2. Overall Unit Thickness: 1-5/16 inch.
3. Minimum Thickness of Outdoor Lite: 6 mm.
4. Outdoor Lite: Clear heat-strengthened low-iron float glass.
5. Interspace Content: Air.
6. Indoor Lite: Clear laminated glass with two plies of annealed low-iron float glass.
    a. Minimum Thickness of Each Glass Ply: 6 mm.
    b. Interlayer Thickness: 0.060 inch.
7. Low-E Coating: Sputtered on second surface.
8. Winter Nighttime U-Factor: 0.28 maximum.
9. Visible Light Transmittance: 68 percent minimum.
10. SGHC: 0.28 maximum.
1. Provide fully tempered safety glazing at locations indicated and where required to comply with applicable building codes, standards and regulations.

B. Ceramic-Coated, Low-E-Coated, Clear Insulating Laminated Vision Glass Type GL-2 (skylight):

1. Basis-of-Design Product: Vitro; Solarban 70 on Clear glass.
2. Ceramic Coating Color and Pattern: As selected by Architect from manufacturer's full range.
    a. Color: Warm neutral gray.
    b. Pattern: 1/8 inch diameter holes; offset rows; 60 percent coverage.
3. Overall Unit Thickness: 1-5/16 inch.
4. Minimum Thickness of Outdoor Lite: 6 mm.

5. Outdoor Lite: Clear heat-strengthened float glass.
6. Interspace Content: Air.
7. Indoor Lite: Clear laminated glass with two plies of annealed float glass.

    a. Minimum Thickness of Each Glass Ply: 6 mm.
    b. Interlayer Thickness: 0.060 inch.

8. Low-E Coating: Sputtered on second surface.
9. Winter Nighttime U-Factor: 0.28 maximum.
10. Visible Light Transmittance: 40 percent +/- 5 percent.
11. SGHC: 0.20 maximum.
12. Coating Location: Second surface.

END OF SECTION

SECTION 08 81 13 - DECORATIVE GLASS GLAZING

PART 1 - GENERAL

1.1 SUMMARY

A. Description of Work: Provide laminated glass with custom printed interlayer to emulate alabaster at Supreme Court Courtroom 5202.

B. Section Includes:

1. Laminated decorative glass.

C. Related Requirements:

1. Section 057000 “Decorative Metal” for laylite framing glazed with decorative glass glazing.
2. Section 057313 "Glazed Decorative Metal Railings" for glass panels in metal railings and in glass- and plastic-supported railings.
3. Section 088000 “Glazing” for general glazing.
4. Section 088853 “Security Glazing” for ballistic and forced-entry glazing.
5. Section 088300 "Mirrors" for mirror glass.

1.2 DEFINITION

A. Glass Thickness: Indicated by thickness designations in millimeters in accordance with ASTM C1036.

1.3 COORDINATION

A. Coordinate glazing channel dimensions to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Glass Samples: For decorative glass with custom printed interlayer.

1. Size: 12 inches square.
2. Transparency: Range samples from 50 percent to 10 percent transparent.

C. Delegated Design Submittal: For decorative glass indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Sample Warranty: For special warranty.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer who employs glass installers for this Project who are certified under NGA's Certified Glass Installer Program.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Protect decorative glass and glazing materials according to manufacturer's written instructions. Prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.

1.8 FIELD CONDITIONS

A. Environmental Limitations: Do not deliver or install decorative glass until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

B. Field Measurements: Verify actual dimensions of openings and construction contiguous with decorative glass by field measurements before fabrication.

1.9 WARRANTY

A. Special Warranty on Laminated Glass: Manufacturer agrees to replace laminated-glass units that deteriorate within specified warranty period. Deterioration of laminated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning laminated glass contrary to manufacturer's written instructions. Defects include edge separation, delamination materially obstructing vision through glass, and blemishes exceeding those allowed by referenced laminated-glass standard.

1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS OF DECORATIVE GLASS

A. Source Limitations for Glass: Obtain each type of decorative glass from single source from single manufacturer.

B. Source Limitations for Glazing Accessories: Obtain from single source from single manufacturer, for each product and installation method.

2.2 PERFORMANCE REQUIREMENTS

A. General Performance: Installed glazing systems shall withstand normal thermal movement and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, or installation; deterioration of glazing materials; or other defects in construction.

B. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design decorative glass.

2.3 GLASS PRODUCTS, GENERAL

A. Glazing Publications: Comply with glass product manufacturers' written instructions, NGA's "Laminated Glazing Reference Manual," and NGA's "GANA Glazing Manual" unless more stringent requirements are indicated. See these publications for glazing terms not otherwise defined in this Section or in referenced standards.

B. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass lites in thicknesses as needed to comply with requirements indicated.

C. Strength: Where annealed float glass is indicated, provide annealed float glass, heat-strengthened float glass, or fully tempered float glass as needed to comply with requirements indicated. Where heat-strengthened glass is indicated, provide heat-strengthened float glass or fully tempered float glass as needed to comply with requirements indicated. Where fully tempered glass is indicated, provide fully tempered float glass.

2.4 GLASS PRODUCTS

A. Low-Iron Float Glass: ASTM C1036, Type I, Class I, Quality-Q3, and with visible light transmission not less than 91 percent.

B. Laminated Glass: ASTM C1172. Use materials that have a proven record of no tendency to bubble, discolor, or lose physical and mechanical properties after fabrication and installation.

2.5 GLAZING MATERIALS

A. Glazing Sealants, Tapes, and Miscellaneous Glazing Materials: As specified in Section 08 80 00 "Glazing."

1. Colors: As selected by Architect from manufacturer's full range.

2.6 DECORATIVE GLASS FABRICATION

A. Fabricate decorative glass and provide other glazing products in sizes required to glaze openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with product manufacturer's written instructions and with referenced glazing standard.

B. Edge Finishing: Finish edges smooth and polished, without chips, scratches, or warps.

1. Finished Edge: Flat polished.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine decorative glass framing members, with Installer present, for compliance with the following:

1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
2. Minimum required face or edge clearances.
3. Effective sealing between joints of decorative glass framing members.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.

B. Examine glazing units to locate orientation of outer surfaces. Label or mark units as needed so that surface orientation is readily identifiable. Do not use materials that leave visible marks in the completed Work.

3.3 INSTALLATION

A. Set decorative glass units in each series true in line with uniform orientation, pattern, draw, bow, and similar characteristics.

B. Set glass lites with proper orientation so that each outer surface faces the direction indicated on Drawings.

3.4 GLAZING, GENERAL

A. Decorative Glass: Install glazing as specified in Section 088000 "Glazing."

3.5 CLEANING AND PROTECTION

A. Immediately after installation, remove nonpermanent labels and clean surfaces.

B. Protect glass from contact with contaminating substances resulting from construction operations. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended in writing by glass manufacturer.

C. Remove and replace glass that is damaged during construction period.

D. Wash glass on both exposed surfaces not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended in writing by glass manufacturer.

3.6 DECORATIVE GLASS SCHEDULE

A. Laminated Glass Type DG-1: Laminated glass with custom printed decorative interlayer.

1. Basis-of-Design Product: **McGrory Glass** or comparable product by one of the following:

    a. FGD Glass Solutions
    b. Goldray Glass.

2. Construction: Two plies of low-iron, float glass.
3. Thickness of Each Glass Ply: 6 mm.
4. Interlayer Type: Laminate glass with PVB interlayer to comply with interlayer manufacturer's written instructions.
5. Interlayer Thickness: 0.030 inch minimum.
6. Interlayer Color and Pattern: Custom pattern to emulate alabaster based on image provided by Architect.
7. Transparency: As selected by Architect from custom samples of 50 percent to 10 percent transparency in 10 percent increments.

END OF SECTION

This page is intentionally left blank.

SECTION 08 83 00 - MIRRORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Silvered flat glass mirrors.

B. Related Requirements:

1. Section 102800 "Toilet, Bath, and Laundry Accessories" for metal-framed mirrors.

1.2 ACTION SUBMITTALS

A. Sustainable Design Submittals:

1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.
2. Product Data: For adhesives, indicating VOC content.
3. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting materials.

B. Shop Drawings: Include mirror elevations, edge details, mirror hardware, and attachment details.

C. Samples: For each type of the following:

1. Mirrors: 12 inches square, including edge treatment on two adjoining edges.
2. Mirror Trim: 12 inches long.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Certificates: For each type of mirror.

C. Sample Warranty: For special warranty.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For mirrors to include in maintenance manuals.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: A qualified Installer, who employs glass installers for this Project who are certified under the National Glass Association's Certified Glass Installer Program.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Protect mirrors in accordance with mirror manufacturer's written instructions and as needed to prevent damage to mirrors from moisture, condensation, temperature changes, direct exposure to sun, or other causes.

B. Comply with mirror manufacturer's written instructions for shipping, storing, and handling mirrors as needed to prevent deterioration of silvering, damage to edges, and abrasion of glass surfaces and applied coatings. Store indoors.

1.7 FIELD CONDITIONS

A. Environmental Limitations: Do not install mirrors until ambient temperature and humidity conditions are maintained at levels indicated for final occupancy.

1.8 WARRANTY

A. Special Warranty: Manufacturer agrees to replace mirrors that deteriorate within specified warranty period. Deterioration of mirrors is defined as defects developed from normal use that are not attributed to mirror breakage or to maintaining and cleaning mirrors contrary to manufacturer's written instructions. Defects include discoloration, black spots, and clouding of the silver film.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Source Limitations for Mirrors: Obtain mirrors from single source from single manufacturer.

B. Source Limitations for Mirror Accessories: Obtain mirror-glazing accessories from single source.

2.2 SILVERED FLAT GLASS MIRRORS

A. Mirrors, General: ASTM C1503.

B. Annealed Monolithic Glass Mirrors: Mirror Select Quality, clear.

1. Nominal Thickness: 6.0 mm.

C. Tempered Glass Mirrors: Mirror Glazing Quality for blemish requirements and complying with ASTM C1048 for Kind FT, Condition A, tempered float glass before silver coating is applied; clear.

1. Nominal Thickness: 6.0 mm.

D. Safety Glazing Products: For tempered mirrors, provide products that comply with 16 CFR 1201, Category II.

2.3 MISCELLANEOUS MATERIALS

A. Edge Sealer: Coating compatible with glass coating and approved by mirror manufacturer for use in protecting against silver deterioration at mirrored glass edges.

2.4 MIRROR HARDWARE

A. Aluminum J-Channels: Aluminum extrusions with a return deep enough to produce a glazing channel to accommodate mirrors of thickness indicated and in lengths required to cover edges of mirrors in a single piece.

1. Aluminum J-Channel Bottom and Side Trim: J-channels formed with front leg and back leg not less than 3/8 and 7/8 inch in height, respectively, and a thickness of not less than 0.04 inch.

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) Andscot Company, Inc.
2) C.R. Laurence Co., Inc.; CRH Americas, Inc.
3) Stylmark, Inc.

2. Aluminum J-Channel Top Trim: J-channels formed with front leg and back leg not less than 5/8 and 1 inch in height, respectively, and a thickness of not less than 0.04 inch.

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) Andscot Company, Inc.
2) C.R. Laurence Co., Inc.; CRH Americas, Inc.
3) Stylmark, Inc.

3. Finish: Clear bright anodized.

B. Fasteners: Fabricated of same basic metal and alloy as fastened metal and matching it in finished color and texture where fasteners are exposed.

C. Anchors and Inserts: Provide devices as required for mirror hardware installation. Provide toothed or lead-shield, expansion-bolt devices for drilled-in-place anchors. Provide galvanized anchors and inserts for applications on inside face of exterior walls and where indicated.

2.5 FABRICATION

A. Shop fabricate mirrors to greatest extent possible.

B. Fabricate cutouts for notches and holes in mirrors without marring visible surfaces. Locate and size cutouts, so they fit closely around penetrations in mirrors.

C. Mirror Edge Treatment: Flat polished.

1. Seal edges of mirrors with edge sealer after edge treatment to prevent chemical or atmospheric penetration of glass coating.
2. Require mirror manufacturer to perform edge treatment and sealing in factory immediately after cutting to final sizes.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, over which mirrors are to be mounted, with Installer present, for compliance with installation tolerances, substrate preparation, and other conditions affecting performance of the Work.

B. Verify compatibility with and suitability of substrates, including compatibility of existing finishes or primers with mirror mastic.

C. Proceed with installation only after unsatisfactory conditions have been corrected and surfaces are dry.

3.2 INSTALLATION

A. General: Install mirrors to comply with mirror manufacturer's written instructions and with referenced National Glass Association (NGA) publications. Mount mirrors accurately in place in a manner that avoids distorting reflected images.

1. NGA Publications: "Glazing Manual" and "Installation Techniques Designed to Prolong the Life of Flat Glass Mirrors."

B. Provide a minimum airspace of 1/8 inch between back of mirrors and mounting surface for air circulation between back of mirrors and face of mounting surface.

C. Install mirrors withmirror hardware. Attach mirror hardware securely to mounting surfaces with mechanical fasteners installed with anchors or inserts as applicable. Install fasteners so heads do not impose point loads on backs of mirrors.

1. Aluminum J-Channels: Provide setting blocks 1/8 inch thick by 4 inches long at quarter points. To prevent trapping water, provide, between setting blocks, two slotted weeps not less than 1/4 inch wide by 3/8 inch long at bottom channel.

3.3 CLEANING AND PROTECTION

A. Protect mirrors from breakage and contaminating substances resulting from construction operations.

B. Do not permit edges of mirrors to be exposed to standing water.

C. Maintain environmental conditions that prevent mirrors from being exposed to moisture from condensation or other sources for continuous periods of time.

D. Clean exposed surface of mirrors not more than four days before date scheduled for inspections that establish date of Substantial Completion. Clean mirrors as recommended in writing by mirror manufacturer and NGA's publication "Proper Procedures for Cleaning Flat Glass Mirrors."

END OF SECTION

This page is intentionally left blank.

SECTION 08 88 53 - SECURITY GLAZING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:

1. Polycarbonate security glazing.
2. Insulating security glazing.

B. Related Requirements:

1. Section 085653 "Security Windows."

1.2 DEFINITIONS

A. Glazing Manufacturers: Firms that produce primary glass, monolithic plastic glazing, or fabricated security glazing, as defined in referenced glazing publications.

B. Interspace: Space between lites of air-gap security glazing or insulating security glazing.

1.3 COORDINATION

A. Coordinate glazing channel dimensions to provide necessary bite on security glazing, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples for Verification:

1. Glazing: Actual sample of finished products for each type of security glazing.

a. Size: Manufacturers' standard size.

C. Delegated Design Submittal: For security glazing, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

D. Sustainable Design Submittals:

1. Product Data: For sealants, indicating VOC content.
2. Laboratory Test Reports: For sealants, indicating compliance with requirements for low-emitting materials.

1.5 INFORMATIONAL SUBMITTALS

A. Test and Evaluation Reports:

1. Product Test Reports:

a. For each type of security glazing, for tests performed by qualified testing agency.
b. For each type of glazing sealant, for tests performed by a qualified testing agency.

1) Provide test reports based on testing current sealant formulations within previous 36-month period.

B. Qualification Statements: For installers.

C. Delegated design engineer qualifications.

D. Sample warranties.

1.6 QUALITY ASSURANCE

A. Qualifications:

1. Manufacturers: For insulating security glazing units with sputter-coated, low-e coatings, a qualified insulating glazing manufacturer who is approved by coated-glass manufacturer.
2. Installers: Authorized representative who is trained and approved by manufacturer.
3. Delegated Design Engineer: A professional engineer who is legally qualified to practice in state where Project is located and who is experienced in providing engineering services of type indicated.
4. Security Glazing Testing Agency: Subject to compliance with requirements, testing agency is one of the following:

a. Intertek.
b. Underwriters Laboratories, Inc.
c. Wiss, Janney, Elstner Associates, Inc.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Protect security glazing and glazing materials according to manufacturer's written instructions. Prevent damage from condensation, temperature changes, direct exposure to sun, or other causes.

B. Comply with insulating security glazing manufacturers' written recommendations for venting and sealing units to avoid hermetic seal ruptures due to altitude change.

1.8 FIELD CONDITIONS

A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.

1. Do not install glazing sealants when ambient and substrate temperature conditions are outside limits permitted by sealant manufacturer or below 40 deg F.

1.9 WARRANTY

A. Special Warranty, Coated Glass: Manufacturer agrees to replace coated glass that fails in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Defects developed in coated glass from normal use that is not attributed to glass breakage or to maintaining and cleaning coated glass contrary to manufacturer's written instructions. Defects include peeling, cracking, and other indications of deterioration in coating.

2. Warranty Period: 10 years from date of Substantial Completion.

B. Special Warranty, Glass-Clad Polycarbonate Security Glazing: Manufacturer agrees to replace glass-clad polycarbonate security glazing that fails in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning glass-clad polycarbonate security glazing contrary to manufacturer's written instructions. Defects include edge separation, delamination materially obstructing vision through glazing, blemishes exceeding those allowed by referenced polycarbonate standard, yellowing, and loss of light transmission.

2. Warranty Period: 10 years from date of Substantial Completion.

C. Special Warranty, Insulating Security Glazing: Manufacturer agrees to replace insulating security glazing that fails in materials and workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Defects in individual lites developed from normal use or failure of hermetic seal under normal use. Defects in individual lites or failure of hermetic seal that is attributed to glass breakage or to maintaining and cleaning insulating security glazing contrary to manufacturer's written instructions are not included.
b. Defects in coated-glass lites include peeling, cracking, and other indications of deterioration in coating.
c. Defects in laminated-glass lites include edge separation, delamination materially obstructing vision through glass, and blemishes exceeding those allowed by referenced laminated-glass standard.
d. Defects in glass-clad polycarbonate lites include edge separation, delamination materially obstructing vision through glazing, blemishes exceeding those allowed by referenced glass-clad polycarbonate standard, yellowing, and loss of light transmission.
e. Evidence of hermetic seal failure is the obstruction of vision by dust, moisture, or film on interior surfaces of glazing.

2. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Obtain each type of security glazing from single source from single manufacturer.

1. Obtain coated glass from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. General:

1. Installed security glazing will withstand normal thermal movement and wind and impact loads (where applicable) without failure, including loss or breakage attributable to defective manufacture, fabrication, or installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.
2. Installed security glazing will withstand security-related loads and forces without damage to the glazing beyond that allowed by referenced standards.

B. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design security glazing.

C. Structural Performance: Glazing will withstand the following design loads within limits and under conditions indicated.

1. Design Wind Pressures: As indicated on Drawings.

D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.

E. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

F. Safety Glazing: Where safety glazing is indicated, provide glazing that complies with 16 CFR 1201, Category II.

2.3 SECURITY GLAZING, GENERAL

A. Glazing Publications: Comply with published recommendations of security glazing and glazing material manufacturers and organizations below unless more stringent requirements are indicated. Refer to these publications for glazing terms not otherwise defined in this Section or in referenced standards.

1. AAMA Publications: AAMA GDSG-1 and AAMA TIR-A7.
2. IGMA Publication for Sloped Glazing: IGMA TB-3001.
3. IGMA Publication for Insulating Glass: SIGMA TM-3000.
4. NGA Publications: "Laminated Glazing Reference Manual" and "GANA Glazing Manual."

B. Plastic Glazing Labeling: Identify plastic sheets with appropriate markings of applicable testing and inspecting agency, indicating compliance with required fire-test-response characteristics.

C. Safety Glazing Labeling: Where safety glazing is indicated, permanently mark glazing with certification label of the Safety Glazing Certification Council the Safety Glazing Certification Council or another certification agency acceptable to authorities having jurisdiction or manufacturer. Label will indicate manufacturer's name, type of glazing, glass thickness, and safety glazing standard with which glazing complies.

D. Insulating Glazing Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of the Insulating Glass Certification Council.

E. Thickness of Tinted Glass: Provide same thickness for each tint color indicated throughout Project.

F. Fire-Test-Response Characteristics of Polycarbonate Sheets: As determined by testing polycarbonate sheets identical to those used in security glazing products by a qualified testing agency acceptable to authorities having jurisdiction.

1. Self-ignition temperature of 650 deg F or more when tested in accordance with ASTM D1929 on plastic sheets in thicknesses indicated for the Work.
2. Smoke-Developed Index of 450 or less when tested in accordance with ASTM E84 or UL 723, or smoke density of 75 or less when tested in accordance with ASTM D2843 on plastic sheets in thicknesses indicated for the Work.
3. Burning extent of 1 inch or less when tested in accordance with ASTM D635 at a nominal thickness of 0.060 inch or thickness indicated for the Work.

G. Thermal and Optical Performance Properties: Provide security glazing with performance properties specified, as indicated in manufacturer's published test data, based on construction products indicated and on procedures indicated below:

1. U-Factors: Center-of-glazing values, in accordance with NFRC 100 and based on most current non-beta version of LBL's WINDOW computer program, expressed as Btu/sq. ft. x h x deg F.
2. SHGC and Visible Transmittance: Center-of-glazing values, in accordance with NFRC 200 and based on most current non-beta version of LBL's WINDOW 7.7 computer program.
3. Visible Reflectance: Center-of-glazing values, in accordance with NFRC 300.

2.4 GLASS PRODUCTS

A. Float Glass: ASTM C1036, Type I, Quality-Q3, Class I (clear) unless otherwise indicated.

B. Heat-Treated Float Glass: ASTM C1048; Type I; Quality-Q3; Class I (clear) unless otherwise indicated; of kind and condition indicated.

1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.
2. For heat-strengthened float glass, comply with requirements for Kind HS.
3. For fully tempered float glass, comply with requirements for Kind FT.
4. For uncoated glass, comply with requirements for Condition A.

5. For coated vision glass, comply with requirements for Condition C (other coated glass).

2.5 POLYCARBONATE SECURITY GLAZING

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Dlubak Specialty Glass Corporation; Consolidated Glass Holdings, Inc.
2. Global Security Glazing; Consolidated Glass Holdings, Inc.
3. Insulgard Security Products.
4. Total Security Solutions.
5. US Bulletproofing.

B. Glass-Clad Polycarbonate Security Glazing: ASTM C1349. One or more cores of polycarbonate sheet, clad with glass, bonded with clear urethane interlayer. Use materials that have a proven record of no tendency to bubble, discolor, or lose physical and mechanical properties after fabrication and installation.

2.6 INSULATING SECURITY GLAZING

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Dlubak Specialty Glass Corporation; Consolidated Glass Holdings, Inc.
2. Global Security Glazing; Consolidated Glass Holdings, Inc.
3. Insulgard Security Products.
4. Total Security Solutions.
5. US Bulletproofing.

B. Insulating Security Glazing: Factory-assembled units, consisting of sealed lites of glazing material indicated separated by a dehydrated interspace, qualified in accordance with ASTM E2190

1. Sealing System: Dual seal, with polyisobutylene and silicone primary and secondary sealants.
2. Spacer: Manufacturer's standard spacer material and construction.
3. Desiccant: Molecular sieve or silica gel, or blend of both.

2.7 GLAZING SEALANTS

A. General:

1. Compatibility: Provide glazing sealants that are compatible with one another and with other materials they contact, including security glazing, seals of insulating security glazing and air-gap security glazing, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
2. Suitability: Comply with sealant and security glazing manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.

3. Verify sealant complies with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

B. Glazing Sealant:

1. Neutral-Curing Silicone Glazing Sealant, Class 50: Complying with ASTM C920, Type S, Grade NS, Use NT.

2.8 MISCELLANEOUS GLAZING MATERIALS

A. General: Provide products of material, size, and shape complying with referenced glazing standard, recommended in writing by manufacturers of security glazing and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.

B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.

C. Setting Blocks:

1. Type recommended in writing by sealant or glass manufacturer.

D. Spacers:

1. Type recommended in writing by sealant or security glazing manufacturer.

E. Edge Blocks:

1. Type recommended in writing by sealant or security glazing manufacturer.

2.9 FABRICATION OF SECURITY GLAZING

A. Fabricate security glazing in sizes required to fit openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.

B. Grind smooth and polish exposed security glazing edges and corners.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine framing for security glazing, with Installer present, for compliance with the following:

1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.

2. Presence and functioning of weep system.
3. Minimum required face or edge clearances.
4. Minimum required bite.
5. Effective sealing between joints of framing members.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean glazing channels and other framing members receiving security glazing immediately before glazing. Remove coatings not firmly bonded to substrates.

B. Examine glazing units to locate exterior and interior surfaces. Label or mark units as needed so that exterior and interior surfaces are readily identifiable. Do not use materials that will leave visible marks in the completed work.

3.3 GLAZING, GENERAL

A. Comply with combined written instructions of manufacturers of security glazing, sealants, gaskets, and other glazing materials unless more stringent requirements are indicated, including those in referenced glazing publications.

B. Protect edges of security glazing from damage during handling and installation. Remove damaged security glazing from Project site and legally dispose of it off Project site. Damaged security glazing includes units with edge or face damage or other imperfections that, when installed, could weaken security glazing and impair performance and appearance.

C. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.

D. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications unless otherwise required by glazing unit manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.

E. Do not exceed edge pressures stipulated by security glazing manufacturers for installing lites.

F. Provide spacers for security glazing lites where the length plus width is larger than 50 inches.

1. Locate spacers directly opposite each other on both inside and outside faces of security glazing. Install correct size and spacing to preserve required face clearances unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with performance requirements.
2. Provide 1/8-inch minimum bite of spacers on glazing lites and use thickness equal to sealant width. With glazing tape, use thickness of slightly less than final compressed thickness of tape.

G. Provide edge blocking where indicated or needed to prevent security glazing from moving sideways in glazing channel, as recommended in writing by security glazing manufacturer and in accordance with requirements in referenced glazing publications.

H. Set security glazing in each series with uniform pattern, draw, bow, and similar characteristics.

I. Set coated security glazing with proper orientation so that coatings and films face exterior or interior as specified.

J. Where wedge-shaped gaskets are driven into one side of channel to pressurize sealant or gasket on opposite side, provide adequate anchorage so gasket cannot walk out when installation is subjected to movement.

K. Square cut wedge-shaped gaskets at corners and install gaskets in a manner recommended by gasket manufacturer to prevent corners from pulling away; seal corner joints and butt joints with sealant recommended in writing by gasket manufacturer.

3.4 GASKET GLAZING (DRY)

A. Cut compression gaskets to lengths recommended in writing by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.

B. Insert soft compression gasket between glazing unit and frame or fixed stop, so it is securely in place with joints miter cut and bonded together at corners.

C. Installation with Drive-in Wedge Gaskets: Center security glazing in openings on setting blocks and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in security glazing. Seal gasket joints with sealant recommended in writing by gasket manufacturer.

D. Installation with Pressure-Glazing Stops: Center security glazing in openings on setting blocks and press firmly against soft compression gasket. Install dense compression gaskets and pressure-glazing stops, applying pressure uniformly to compression gaskets. Compress gaskets to produce a weathertight seal without developing bending stresses in security glazing. Seal gasket joints with sealant recommended in writing by gasket manufacturer.

E. Install gaskets so they protrude past face of glazing stops.

3.5 CLEANING AND PROTECTION

A. Immediately after installation remove nonpermanent labels and clean surfaces.

B. Protect security glazing from contact with contaminating substances resulting from construction operations, including weld splatter. Examine security glazing surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains.

1. If, despite such protection, contaminating substances do contact with security glazing, remove substances immediately as recommended in writing by security glazing manufacturer. Remove and replace security glazing that cannot be cleaned without damage.

C. Wash security glazing on both exposed surfaces not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash security glazing as recommended in writing by security glazing manufacturer.

3.6 GLASS-CLAD POLYCARBONATE SECURITY GLAZING SCHEDULE

A. Security Glazing Type SG-2: Nonsymmetrical low-iron laminated glass and polycarbonate with glass plies on the attack or threat side and polycarbonate plies on the witness side.

1. Basis-of-Design Product: **Insulgard Security Products; Armor-Gard SP412**.
1. Ballistic Resistance, UL 752: Level 4 in accordance with UL 752.
2. Overall Unit Thickness: 1.22 inches.

    a. Makeup: As required to meet ballistic resistance level.

3. Overall Visible Light Transmittance: 75 percent minimum.
4. Provide safety glazing labeling.

3.7 INSULATING SECURITY GLAZING SCHEDULE

A. Security Glazing Type SG-1: Low-e-coated, clear insulating security glazing. Outdoor lite is made of monolithic glass, and indoor lite is made of glass-clad polycarbonate.

1. Basis-of-Design Product: **Insulgard Security Products; Armor-Gard SP412IG**.
2. Ballistic Resistance, UL 752: Level 4 in accordance with UL 752.
3. Overall Unit Thickness: 1.954 inches.
4. Outdoor Lite: Heat-strengthened low-iron glass.
5. Indoor Lite: Glass-clad polycarbonate.

    a. Makeup: As required to meet ballistic resistance level.

6. Interspace Content: Air.
7. Interspace Dimension: 1/2 inch.
8. Low-E Coating: Sputtered on second surface.
9. Overall Visible Light Transmittance: <**Insert number**> percent minimum.
10. Winter Nighttime U-Factor: <**Insert value**> maximum.
11. Solar-Heat-Gain Coefficient: <**Insert value**> maximum.
12. Provide safety glazing labeling.

END OF SECTION

SECTION 08 91 19 - FIXED LOUVERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Fixed extruded-aluminum louvers.
2. Blank-off panels for louvers

1.2 DEFINITIONS

A. Louver Terminology: Definitions of terms for metal louvers contained in AMCA 501 apply to this Section unless otherwise defined in this Section or in referenced standards.

B. Horizontal Louver: Louver with horizontal blades (i.e., the axis of the blades are horizontal).

C. Drainable-Blade Louver: Louver with blades having gutters that collect water and drain it to channels in jambs and mullions, which carry it to bottom of unit and away from opening.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. For louvers specified to bear AMCA seal, include printed catalog pages showing specified models with appropriate AMCA Certified Ratings Seals.

B. Sustainable Design Submittals:

1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.
2. Environmental Product Declaration: For each product.
3. Health Product Declaration: For each product.
4. Sourcing of Raw Materials: Corporate sustainability report for each manufacturer.

C. Shop Drawings: For louvers and accessories. Include plans, elevations, sections, details, and attachments to other work. Show frame profiles and blade profiles, angles, and spacing.

1. Show weep paths, gaskets, flashings, sealants, and other means of preventing water intrusion.
2. Show mullion profiles and locations.

D. Samples: For each type of metal finish required.

E. Delegated Design Submittal: For louvers indicated to comply with structural[**and seismic**] performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 INFORMATIONAL SUBMITTALS

A. Product Test Reports: Based on evaluation of comprehensive tests performed in accordance with AMCA 500-L by a qualified testing agency or by manufacturer and witnessed by a qualified testing agency, for each type of louver and showing compliance with performance requirements specified.

B. Sample Warranties: For manufacturer's special warranties.

1.5 FIELD CONDITIONS

A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

1.6 WARRANTY

A. Special Finish Warranty, Factory-Applied Finishes: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of baked enamel, powder coat, or organic finishes within specified warranty period.

1. Deterioration includes, but is not limited to, the following:

a. Color fading more than 5 Delta E units when tested in accordance with ASTM D2244.
b. Chalking in excess of a No. 8 rating when tested in accordance with ASTM D4214.
c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain fixed louvers from single source from a single manufacturer where indicated to be of same type, design, or factory-applied color finish.

2.2 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design louvers, including comprehensive engineering analysis by a qualified professional engineer, using structural performance requirements and design criteria indicated.

B. Structural Performance: Louvers withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated without permanent deformation of louver components, noise or metal fatigue caused by louver-blade rattle or flutter, or permanent damage to fasteners and anchors. Wind pressures are considered to act normal to the face of the building.

1. Wind Loads:

a. Determine loads based on pressures as indicated on Drawings.

C. Louver Performance Ratings: Provide louvers complying with requirements specified, as demonstrated by testing manufacturer's stock units identical to those provided, except for length and width in accordance with AMCA 500-L.

D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.

1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

E. SMACNA Standard: Comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" for fabrication, construction details, and installation procedures.

2.3 FIXED EXTRUDED-ALUMINUM LOUVERS

A. Horizontal Drainable-Blade Louver, Extruded Aluminum L5, L6, L7, L8:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Air Balance; MESTEK, Inc.
b. Airline Louvers; Mestek, Inc.
c. Airolite Company, LLC (The).
d. Construction Specialties, Inc.
e. Greenheck Fan Corporation.
f. Ruskin; Air Distribution Technologies, Inc.; Johnson Controls, Inc.

2. Louver Depth: 6 inches.
3. Frame and Blade Nominal Thickness: Not less than 0.080 inch.
4. Mullion Type: Exposed at perimeter only; hidden intermediate vertical supports.
5. Louver Performance Ratings:

a. Free Area: Not less than 9 sq. ft. for 48-inch-wide by 48-inch-high louver.
b. Point of Beginning Water Penetration: Not less than 1000 fpm.
c. Air Performance:

1) Not more than 0.10-inch wg static pressure drop at 800-fpm free-area intake velocity.

6. AMCA Seal: Mark units with AMCA Certified Ratings Seal.

B. Horizontal, Continuous-Line, Drainable-Blade and Wind-Driven-Rain-Resistant Louver, Extruded Aluminum L1, L2: Drainable-blade louver with blade gutters (drains) in rear two-thirds of blades only.

1. Basis-of-Design Product: Subject to compliance with requirements, provide **Construction Specialties, Inc.; RS-7705 Full Blade** or a comparable product by one of the following:

    a. Airline Louvers; Mestek, Inc.
    b. Airolite Company, LLC (The).
    c. All-Lite Architectural Products.
    d. Greenheck Fan Corporation.
    e. Ruskin; Air Distribution Technologies, Inc.; Johnson Controls, Inc.

2. Louver Depth: 7 inches.
3. Frame and Blade Nominal Thickness: Not less than 0.080 inch.
4. Mullion Type: Semirecessed.
5. Louver Performance Ratings:

    a. Free Area: Not less than 8.0 sq. ft. for 48-inch-wide by 48-inch-high louver.
    b. Point of Beginning Water Penetration: Not less than 1000 fpm.
    c. Air Performance: Not more than 0.10-inch wg static pressure drop at 700-fpm free-area intake velocity.

6. AMCA Seal: Mark units with AMCA Certified Ratings Seal.

C. Horizontal, Wind-Driven-Rain-Resistant Louver, Extruded Aluminum L3, L4:

1. Basis-of-Design Product: Subject to compliance with requirements, provide **Construction Specialties, Inc.; RS-7705** or a comparable product by one of the following:

    a. Airline Louvers; Mestek, Inc.
    b. Airolite Company, LLC (The).
    c. Greenheck Fan Corporation.
    d. Ruskin; Air Distribution Technologies, Inc.; Johnson Controls, Inc.

2. Louver Depth: 7 inches.
3. Frame and Blade Nominal Thickness: Not less than 0.080 inch.
4. Louver Performance Ratings:

    a. Free Area: Not less than 8.00 sq. ft. for 48-inch-wide by 48-inch-high louver.
    b. Air Performance: Not more than 0.10-inch wg static pressure drop at 700-fpm free-area exhaust velocity.
    c. Wind-Driven Rain Performance: Not less than 99 percent effectiveness when subjected to a rainfall rate of 3 inches per hour and a wind speed of 29 mph at a core-area intake velocity of 800 fpm.

5. AMCA Seal: Mark units with AMCA Certified Ratings Seal.

2.4 LOUVER SCREENS

A. General: Provide screen at each exterior louver.

1. Screen Location for Fixed Louvers: Interior face.
2. Screening Type: Insect screening.

B. Secure screen frames to louver frames with stainless steel machine screws, spaced a maximum of 6 inches from each corner and at 12 inches o.c.

C. Louver Screen Frames: Fabricate with mitered corners to louver sizes indicated.

1. Metal: Same type and form of metal as indicated for louver to which screens are attached. Reinforce extruded-aluminum screen frames at corners with clips.
2. Finish: Mill finish unless otherwise indicated.
3. Type: Rewirable frames with a driven spline or insert.

D. Louver Screening for Aluminum Louvers:

1. Insect Screening, Aluminum: 18-by-16 mesh, 0.012-inch wire.

2.5 BLANK-OFF PANELS

A. Insulated Blank-Off Panels: Laminated panels consisting of an insulating core surfaced on back and front with metal sheets and attached to back of louver.

1. Thickness: 1 inch.
2. Metal Facing Sheets, Aluminum: Not less than 0.032-inch nominal thickness.
3. Insulating Core: Extruded-polystyrene foam.
4. Edge Treatment: Trim perimeter edges of blank-off panels with louver manufacturer's standard extruded-aluminum-channel frames, not less than 0.080-inch nominal thickness, with corners mitered and with same finish as panels.
5. Seal perimeter joints between panel faces and louver frames with gaskets or sealant.
6. Panel Finish: Same type of finish applied to louvers, but black color.
7. Attach blank-off panels with clips.

2.6 MATERIALS

A. Aluminum Extrusions: ASTM B211, Alloy 6063-T5, T-52, or T6.

B. Aluminum Sheet: ASTM B209, Alloy 3003 or 5005, with temper as required for forming, or as otherwise recommended by metal producer for required finish.

C. Fasteners: Use types and sizes to suit unit installation conditions.

1. Use Phillips flat-head screws for exposed fasteners unless otherwise indicated.
2. For fastening aluminum, use aluminum or 300 series stainless steel fasteners.
3. For color-finished louvers, use fasteners with heads that match color of louvers.

D. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.

E. Recycled Content of Aluminum Components: Provide products with postconsumer recycled content plus one-half of preconsumer recycled content to the extent required to comply with the minimum criteria specified in Section 01 81 13.33 “Sustainable Design Requirements – IGCC/ASHRAE 189.1.”

F. Regional Materials: To the extent required to comply with the minimum criteria specified in Section 01 81 13.14 “Sustainable Design Requirements,” manufacture products within 100 miles of Project site from materials that have been extracted, harvested, or recovered, as well as manufactured, within 100 miles of Project site.

2.7 FABRICATION

A. Factory assemble louvers to minimize field splicing and assembly. Disassemble units as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.

B. Vertical Assemblies: Where height of louver units exceeds fabrication and handling limitations, fabricate units to permit field-bolted assembly with close-fitting joints in jambs and mullions, reinforced with splice plates.

1. Continuous Vertical Assemblies: Fabricate units without interrupting blade-spacing pattern.

C. Maintain equal louver blade spacing, including separation between blades and frames at head and sill, to produce uniform appearance.

D. Fabricate frames, including integral sills, to fit in openings of sizes indicated, with allowances made for fabrication and installation tolerances, adjoining material tolerances, and perimeter sealant joints.

1. Frame Type: Channel unless otherwise indicated.

E. Include supports, anchorages, and accessories required for complete assembly.

F. Provide vertical mullions of type and at spacings indicated, but not more than is recommended by manufacturer, or 72 inches o.c., whichever is less.

1. Semirecessed Mullions: Where indicated, provide mullions partly recessed behind louver blades, so louver blades appear continuous. Where length of louver exceeds fabrication and handling limitations, fabricate with interlocking split mullions and close-fitting blade splices designed to permit expansion and contraction.
2. Exposed Mullions: Where indicated, provide units with exposed mullions of same width and depth as louver frame. Where length of louver exceeds fabrication and handling limitations, provide interlocking split mullions designed to permit expansion and contraction.

G. Provide subsills made of same material as louvers or extended sills for recessed louvers.

H. Join frame members to each other and to fixed louver blades with fillet welds concealed from view, threaded fasteners, or both, as standard with louver manufacturer unless otherwise indicated or size of louver assembly makes bolted connections between frame members necessary.

2.8 ALUMINUM FINISHES

A. Finish louvers after assembly.

B. High-Performance Organic Finish, Two-Coat PVDF: Fluoropolymer finish complying with AAMA 2605 and containing not less than 70 percent PVDF resin by weight in color coat.

1. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
2. Color and Gloss: As preselected and indicated in Finish Schedule.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and openings, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Coordinate setting drawings, diagrams, templates, instructions, and directions for installation of anchorages that are to be embedded in concrete or masonry construction. Coordinate delivery of such items to Project site.

3.3 INSTALLATION

A. Locate and place louvers level, plumb, and at indicated alignment with adjacent work.

B. Use concealed anchorages where possible. Provide brass or lead washers fitted to screws where required to protect metal surfaces and to make a weathertight connection.

C. Form closely fitted joints with exposed connections accurately located and secured.

D. Provide perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.

E. Protect unpainted galvanized- and nonferrous-metal surfaces that are in contact with concrete, masonry, or dissimilar metals from corrosion and galvanic action by applying a heavy coating of bituminous paint or by separating surfaces with waterproof gaskets or nonmetallic flashing.

F. Install concealed gaskets, flashings, joint fillers, and insulation as louver installation progresses, where weathertight louver joints are required. Comply with Section 079200 "Joint Sealants" for sealants applied during louver installation.

3.4 ADJUSTING AND CLEANING

A. Clean exposed louver surfaces that are not protected by temporary covering, to remove fingerprints and soil during construction period. Do not let soil accumulate during construction period.

B. Before final inspection, clean exposed surfaces with water and a mild soap or detergent not harmful to finishes. Thoroughly rinse surfaces and dry.

C. Restore louvers damaged during installation and construction, so no evidence remains of corrective work. If results of restoration are unsuccessful, as determined by Architect, remove damaged units and replace with new units.

1. Touch up minor abrasions in finishes with air-dried coating that matches color and gloss of, and is compatible with, factory-applied finish coating.

END OF SECTION

SECTION 09 05 61.13 - MOISTURE VAPOR EMISSION CONTROL

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Fluid-applied, resin-based, membrane-forming systems that control the moisture-vapor-emission rate of high-moisture, interior concrete to prepare it for floor covering installation.

1.2 DEFINITIONS

A. MVE: Moisture vapor emission.

B. MVER: Moisture vapor emission rate.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:

1. Product Data: For coatings, indicating VOC content.
2. Laboratory Test Reports: For coatings, indicating compliance with requirements for low-emitting materials.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer, manufacturer.

B. Product Test Reports: For each MVE-control system, for tests performed by manufacturer and witnessed by a qualified testing agency.

C. Preinstallation testing reports.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Employs factory-trained personnel who are available for consultation and Project-site inspection.

B. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in original packages and containers, with seals unbroken, bearing manufacturer's labels indicating directions for storage and mixing with other components.

1.7 FIELD CONDITIONS

A. Environmental Limitations: Comply with MVE-control system manufacturer's written instructions for substrate and ambient temperatures, humidity, ventilation, and other conditions affecting system installation.

1. Store system components in a temperature-controlled environment and protected from weather and at ambient temperature of not less than 65 deg F and not more than 85 deg F at least 48 hours before use.
2. Maintain ambient temperature and relative humidity in installation areas within range recommended in writing by MVE-control system manufacturer, but not less than 65 deg F or more than 85 deg F and not less than 40 or more than 60 percent relative humidity, for 48 hours before installation, during installation, and for 48 hours after installation unless longer period is recommended in writing by manufacturer.
3. Install MVE-control systems where concrete surface temperatures will remain a minimum of 5 deg F higher than the dew point for ambient temperature and relative humidity conditions in installation areas for 48 hours before installation, during installation, and for 48 hours after installation unless longer period is recommended in writing by manufacturer.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. MVE-Control System Capabilities: Capable of suppressing MVE without failure where installed on concrete that exhibits the following conditions:

1. Relative Humidity: Maximum 100 percent when tested according to ASTM F2170 using in situ probes.

B. Water-Vapor Transmission: Through MVE-control system, maximum 0.10 perm when tested according to ASTM E96/E96M.

C. Tensile Bond Strength: For MVE-control system, greater than 200 psi with failure in the concrete according to ASTM D7234.

2.2 MVE-CONTROL SYSTEM

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. ARDEX Americas.
2. Floor Seal Technology, Inc.
3. KOSTER American Corporation.

B. MVE-Control System: ASTM F3010-qualified, fluid-applied, two-component, epoxy-resin, membrane-forming system; formulated for application on concrete substrates to reduce MVER to level required for installation of floor coverings indicated and acceptable to manufacturers of floor covering products indicated, including adhesives.

1. Substrate Primer: Provide MVE-control system manufacturer's concrete-substrate primer if required for system indicated by substrate conditions.
2. Cementitious Underlayment Primer: If required for subsequent installation of cementitious underlayment products, provide MVE-control system manufacturer's primer to ensure adhesion of products to MVE-control system.
3. VOC Content: Provide coating with VOC content of 100 g/L or less.
4. Low-Emitting Materials: Verify coating complies with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

2.3 ACCESSORIES

A. Patching and Leveling Material: Moisture-, mildew-, and alkali-resistant product recommended in writing by MVE-control system manufacturer and with minimum of 3000-psi compressive strength after 28 days when tested according to ASTM C109/C109M.

B. Crack-Filling Material: Resin-based material recommended in writing by MVE-control system manufacturer for sealing concrete substrate crack repair.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for maximum moisture content, installation tolerances, and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

1. Installation of system indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Preinstallation Testing:

1. Testing Agency: Engage a qualified testing agency to perform tests.
2. Alkalinity Testing: Perform pH testing according to ASTM F710. Install MVE-control system in areas where pH readings are less than 7.0 and in areas where pH readings are greater than 8.5.
3. Moisture Testing: Perform tests so that each test area does not exceed 1000 sq. ft., and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.

a. Anhydrous Calcium Chloride Test: ASTM F1869. Install MVE-control system in locations where concrete substrate MVER exceeds 3 lb of water/1000 sq. ft. in 24 hours.
b. Internal Relative Humidity Test: Using in situ probes, ASTM F2170. Install MVE-control system in locations where concrete substrates exhibit relative humidity level greater than 75 percent.

B. Concrete Substrates: Prepare and clean substrates according to MVE-control system manufacturer's written instructions to ensure adhesion of system to concrete.

1. Remove coatings and other substances that are incompatible with MVE-control system and that contain soap, wax, oil, or silicone, using mechanical methods recommended in writing by MVE-control system manufacturer. Do not use solvents.
2. Provide concrete surface profile complying with ICRI 310.2R CSP 3 by shot blasting using apparatus that abrades the concrete surface with shot, contains the dispensed shot within the apparatus, and recirculates the shot by vacuum pickup.
3. After shot blasting, repair damaged and deteriorated concrete according to MVE-control system manufacturer's written instructions.
4. Protect substrate voids and joints to prevent resins from flowing into or leaking through them.
5. Fill surface depressions and irregularities with patching and leveling material.
6. Fill surface cracks, grooves, control joints, and other nonmoving joints with crack-filling material.
7. Allow concrete to dry, undisturbed, for period recommended in writing by MVE-control system manufacturer after surface preparation, but not less than 24 hours.
8. Before installing MVE-control systems, broom sweep and vacuum prepared concrete.

C. Protect walls, floor openings, electrical openings, door frames, and other obstructions during installation.

3.3 INSTALLATION

A. Install MVE-control system according to ASTM F3010 and manufacturer's written instructions to produce a uniform, monolithic surface free of surface deficiencies such as pin holes, fish eyes, and voids.

1. Install primers as required to comply with manufacturer's written instructions.

B. Do not apply MVE-control system across substrate expansion, isolation, and other moving joints.

C. Apply system, including component coats if any, in thickness recommended in writing by MVE-control system manufacturer for MVER indicated by preinstallation testing.

D. Cure MVE-control system components according to manufacturer's written instructions. Prevent contamination or other damage during installation and curing processes.

E. After curing, examine MVE-control system for surface deficiencies. Repair surface deficiencies according to manufacturer's written instructions.

3.4 PROTECTION

A. Protect MVE-control system from damage, wear, dirt, dust, and other contaminants before floor covering installation. Use protective methods and materials, including temporary coverings, recommended in writing by MVE-control system manufacturer.

B. Do not allow subsequent preinstallation examination and testing for floor covering installation to damage, puncture, or otherwise compromise the MVE-control system membrane.

END OF SECTION

This page is intentionally left blank.

SECTION 09 21 16.23 - GYPSUM BOARD SHAFT WALL ASSEMBLIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Gypsum board shaft wall assemblies.

1.2 ACTION SUBMITTALS

A. Product Data: For each component of gypsum board shaft wall assembly.

B. Sustainable Design Submittals:

1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.

1.3 DELIVERY, STORAGE, AND HANDLING

A. Store materials inside under cover and keep them dry and protected against weather, condensation, direct sunlight, construction traffic, and other potential causes of damage. Stack panels flat and support them on risers on a flat platform to prevent sagging.

1.4 FIELD CONDITIONS

A. Environmental Limitations: Comply with gypsum-shaftliner-board manufacturer's written instructions.

B. Do not install finish panels until installation areas are enclosed and conditioned.

C. Do not install panels that are wet, moisture damaged, or mold damaged.

1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, and irregular shape.
2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E119 by an independent testing agency.

B. STC-Rated Assemblies: Provide materials and construction identical to those of assemblies tested according to ASTM E90 and classified according to ASTM E413 by a testing and inspecting agency.

C. Recycled Content: Provide products with postconsumer recycled content plus one-half of preconsumer recycled content to the extent required to comply with the minimum criteria specified in Section 01 81 13.33 “Sustainable Design Requirements – IGCC/ASHRAE 189.1.”

D. Recycled Content of Steel Products: Provide products with postconsumer recycled content plus one-half of preconsumer recycled content to the extent required to comply with the minimum criteria specified in Section 01 81 13.33 “Sustainable Design Requirements – IGCC/ASHRAE 189.1.”

E. Regional Materials: To the extent required to comply with the minimum criteria specified in Section 01 81 13.14 “Sustainable Design Requirements,” manufacture products within 100 miles of Project site from materials that have been extracted, harvested, or recovered, as well as manufactured, within 100 miles of Project site.

F. Delegated Design: Design non-structural wall and ceiling framing, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated. Stud designs indicated on drawings are a minimum.

1. Partition Design Requirements: Provide metal framing systems of base-metal thickness and spacing capable of limiting lateral deflections when subjected to a 5 psf uniform lateral load to the following:

a. L/240 where supporting gypsum board only
b. L/480 where supporting ceramic tile
c. L/600 where supporting interior stone

2. Elevator Hoistway Design Requirements: Provide metal framing systems of base-metal thickness and spacing capable of limiting lateral deflection as indicated above when subjected to the following air pressure loads:

a. Elevator Velocity: 50 – 180 fpm

1) 1 or 2 elevators per shaft: 5psf
2) 3 or more elevators per shaft: 5psf

b. Elevator Velocity: 200 – 700 fpm

1) 1 or 2 elevators per shaft: 7.5 psf
2) 3 or more elevators per shaft: 5 psf

c. Elevator Velocity: 800 – 1600 fpm

1) 1 or 2 elevators per shaft: 10 psf
2) 3 or more elevators per shaft: 7.5 psf

2.2 GYPSUM BOARD SHAFT WALL ASSEMBLIES

A. Fire-Resistance Rating: As indicated on Drawings.

B. STC Rating: As indicated on Drawings.

C. Gypsum Shaftliner Board:

1. Type X: ASTM C1396/C1396M; manufacturer's proprietary fire-resistive liner panels with paper faces, 1 inch thick, with double beveled long edges.

2. Moisture- and Mold-Resistant, Fiberglass-Mat Faced: ASTM C1658/C1658M; manufacturer's proprietary fire-resistive liner panels with ASTM D3273 mold-resistance score of 10 as rated according to ASTM D3274, 1 inch thick, and with double beveled long edges.

D. Non-Load-Bearing Steel Framing, General: Complying with ASTM C645 requirements for metal unless otherwise indicated and complying with requirements for fire-resistance-rated assembly indicated.

1. Protective Coating: Coating with equivalent corrosion resistance of ASTM A653/A653M, G40 unless otherwise indicated.

E. Studs: Manufacturer's standard profile for repetitive, corner, and end members as follows:

1. Depth: As indicated.
2. Minimum Base-Metal Thickness: 0.033 inch.

F. Runner Tracks: Manufacturer's standard J-profile track with manufacturer's standard long-leg length, but at least 2 inches long and matching studs in depth.

1. Minimum Base-Metal Thickness: Matching steel studs.

G. Firestop Tracks: Top runner manufactured to allow partition heads to expand and contract with movement of the structure while maintaining continuity of fire-resistance-rated assembly indicated; in thickness not less than indicated for studs and in width to accommodate depth of studs.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. ClarkDietrich.
b. Fire Trak Corp.
c. Steel Network, Inc. (The).

H. Elevator-Hoistway-Entrance Struts: Manufacturer's standard J-profile jamb strut with long-leg length of 3 inches, matching studs in depth, and not less than 0.033 inch thick.

I. Finish Panels: As indicated.

J. Sound Attenuation Blankets: As specified in Section 09 29 00 "Gypsum Board."

2.3 AUXILIARY MATERIALS

A. Provide auxiliary materials that comply with shaft wall manufacturer's written instructions.

B. Trim Accessories: Cornerbead, edge trim, and control joints of material and shapes as specified in Section 09 29 00 "Gypsum Board" that comply with gypsum board shaft wall assembly manufacturer's written instructions for application indicated.

C. Steel Drill Screws: ASTM C1002 unless otherwise indicated.

D. Track Fasteners: Power-driven fasteners of size and material required to withstand loading conditions imposed on shaft wall assemblies without exceeding allowable design stress of track, fasteners, or structural substrates in which anchors are embedded.

1. Power-Actuated Anchors: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with allowable load capacities calculated according to ICC-ES AC70, greater than or equal to the design load, as determined by testing per ASTM E1190 conducted by a qualified testing agency.

E. Reinforcing: Galvanized-steel reinforcing strips with 0.033-inch minimum thickness of base metal (uncoated).

F. Acoustical Sealant: Section 07 92 19 "Acoustical Joint Sealants."

G. Gypsum Board Cants:

1. Gypsum Board Panels: As specified in Section 09 29 00 "Gypsum Board," Type X, 5/8-inch panels.
2. Adhesive: Laminating adhesive as specified in Section 09 29 00 "Gypsum Board."
3. Non-Load-Bearing Steel Framing: As specified in Section 09 22 16 "Non-Structural Metal Framing."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine panels before installation. Reject panels that are wet, moisture damaged, or mold damaged.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Sprayed Fire-Resistive Materials: Coordinate with gypsum board shaft wall assemblies so both elements of Work remain complete and undamaged. Patch or replace sprayed fire-resistive materials removed or damaged during installation of shaft wall assemblies to comply with requirements specified in Section 078100 "Applied Fire Protection."

B. After sprayed fire-resistive materials are applied, remove only to extent necessary for installation of gypsum board shaft wall assemblies and without reducing the fire-resistive material thickness below that which is required to obtain fire-resistance rating indicated. Protect remaining fire-resistive materials from damage.

3.3 INSTALLATION

A. General: Install gypsum board shaft wall assemblies to comply with requirements of fire-resistance-rated assemblies indicated and manufacturer's written installation instructions.

B. Install supplementary framing in gypsum board shaft wall assemblies around openings and as required for blocking, bracing, and support of gravity and pullout loads of fixtures, equipment, services, heavy trim, furnishings, wall-mounted door stops, and similar items that cannot be supported directly by shaft wall assembly framing.

1. Elevator Hoistway: At elevator hoistway-entrance door frames, provide jamb struts on each side of door frame.
2. Reinforcing: Provide where items attach directly to shaft wall assembly as indicated on Drawings; accurately position and secure behind at least one layer of face panel.

C. Penetrations: At penetrations in shaft wall, maintain fire-resistance rating of shaft wall assembly by installing supplementary steel framing around perimeter of penetration and fire protection behind boxes containing wiring devices, elevator call buttons and floor indicators, and similar items.

D. Isolate perimeter of gypsum panels from building structure to prevent cracking of panels while maintaining continuity of fire-rated construction.

E. Firestop Tracks: Where indicated, install to maintain continuity of fire-resistance-rated assembly indicated.

F. Control Joints: Install control joints according to ASTM C840 and in specific locations approved by Architect while maintaining fire-resistance rating of gypsum board shaft wall assemblies.

G. Sound-Rated Shaft Wall Assemblies: Seal gypsum board shaft walls with acoustical sealant at perimeter of each assembly where it abuts other work and at joints and penetrations within each assembly.

H. Gypsum Board Cants: At projections into shaft exceeding 4 inches, install gypsum board cants covering tops of projections.

1. Slope cant panels at least 75 degrees from horizontal. Set base edge of panels in adhesive and secure top edges to shaft walls at 24 inches o.c. with screws fastened to shaft wall framing.
2. Where non-load-bearing steel framing is required to support gypsum board cants, install framing at 24 inches o.c. and extend studs from the projection to shaft wall framing.

I. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch from the plane formed by faces of adjacent framing.

3.4 PROTECTION

A. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.

B. Remove and replace panels that are wet, moisture damaged, or mold damaged.

1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, and irregular shape.
2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION

SECTION 09 22 16 - NON-STRUCTURAL METAL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Non-load-bearing steel framing systems for interior partitions.
2. Suspension systems for interior ceilings and soffits.
3. Grid suspension systems for gypsum board ceilings.

B. Related Requirements:

1. Section 05 40 00 "Cold-Formed Metal Framing" for exterior and interior load-bearing and exterior non-load-bearing wall studs; floor joists; and roof rafters and ceiling joists.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:

1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.

C. Delegated-Design Submittal: For non-structural wall and ceiling framing indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by a Structural Engineer registered in State of Maryland responsible for their preparation.

1. Structural Calculations: Provide calculations indicating stud base-metal thickness, spacing, and height limitations for each partition type indicated on the Drawings based on both the wall gravity dead load and lateral deflections indicated in Part 2 Article “Performance Requirements.” Where applicable, manufacturer’s published load tables or manufacturer supplied software calculations are acceptable. Provide additional calculation for each instance of non-structural metal framing supporting suspended ceilings including connection design and suspension attachments.

1.3 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of code-compliance certification for studs and tracks.

B. Evaluation Reports: For firestop tracks and power-actuated fasteners, from ICC-ES or other qualified testing agency acceptable to authorities having jurisdiction.

1.4 QUALITY ASSURANCE

A. Code-Compliance Certification of Studs and Tracks: Provide documentation that framing members are certified according to the product-certification program of the Certified Steel Stud Association, the Steel Framing Industry Association, the Steel Stud Manufacturers Association, or the Supreme Steel Framing System Association.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Notify manufacturer of damaged materials received prior to installation.

B. Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.

C. Protect cold-formed metal framing from corrosion, deformation, and other damage during delivery, storage, and handling as required by AISI S202, "Code of Standard Practice for Cold-Formed Steel Structural Framing."

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics: For fire-resistance-rated assemblies that incorporate non-load-bearing steel framing, provide materials and construction identical to those tested in assembly indicated, according to ASTM E119 by an independent testing agency.

B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated on Drawings, according to ASTM E90 and classified according to ASTM E413 by an independent testing agency.

C. Delegated Design: Design non-structural wall and ceiling framing, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

1. Partition Design Requirements: Provide metal framing systems of base-metal thickness and spacing capable of limiting lateral deflections when subjected to a 5 psf uniform lateral load to the following:

    a. L/240 where supporting gypsum board only.
    b. L/360 where supporting plaster finishes.
    c. L/480 where supporting ceramic tile.
    d. L/600 where supporting large-format ceramic tile (greater than 36 inches in any dimension) or stone.

2. Partitions Enclosing Pressurized Mechanical Rooms: Provide metal framing systems of base-metal thickness and spacing capable of limiting lateral deflections to L/240 when subjected to a 15 psf uniform lateral load or the design value induced by the mechanical system, whichever is greater.
3. Suspended Ceiling Design Requirements: Provide metal framing systems of base-metal thickness and spacing capable of limiting ceiling deflections to L/360 when subjected to a minimum 4 psf uniform load or the actual weight of ceiling hung materials, whichever is greater.

D. Design framing systems in accordance with AISI S220, "North American Specification for the Design of Cold-Formed Steel Framing - Nonstructural Members," unless otherwise indicated.

E. Design framing system to allow for construction tolerances, and to accommodate a live load deflection of primary building structure of 1/360 of the span.

2.2 FRAMING SYSTEMS

A. Recycled Content of Steel Products: Provide products with postconsumer recycled content plus one-half of preconsumer recycled content to the extent required to comply with the minimum criteria specified in Section 01 81 13.33 “Sustainable Design Requirements – IGCC/ASHRAE 189.1.”

B. Framing Members, General: Comply with AISI S220 for conditions indicated.

1. Steel Sheet Components: Comply with AISI S220 requirements for metal unless otherwise indicated
2. Protective Coating: Comply with AISI S220; ASTM A653/A653M, G40; or coating with equivalent corrosion resistance. Galvannealed products are unacceptable.

a. Coating demonstrates equivalent corrosion resistance with an evaluation report acceptable to authorities having jurisdiction.

C. Studs and Track: AISI S220.

1. Minimum Base-Steel Thickness: As required by performance requirements for horizontal deflection but not less than 0.0179 inch.
2. Depth: As indicated on Drawings.

D. Slip-Type Head Joints: Where indicated, provide the following:

1. Deflection Track: Steel sheet top track manufactured to prevent cracking of finishes applied to interior partition framing resulting from deflection of structure above; in thickness not less than indicated for studs and in width to accommodate depth of studs.

a. Products: Subject to compliance with requirements, provide one of the following:

1) CEMCO; California Expanded Metal Products Co.; SLP-TRK Slotted Deflection Track.
2) ClarkDietrich; MaxTrak Slotted Deflection Track.
3) Steel Construction Systems; Steel-Con Slotted Leg Track System.
4) Steel Network, Inc. (The); VertiTrack VTD.

E. Firestop Tracks: Top track manufactured to allow partition heads to expand and contract with movement of structure while maintaining continuity of fire-resistance-rated assembly indicated; in thickness not less than indicated for studs and in width to accommodate depth of studs.

1. Products: Subject to compliance with requirements, provide one of the following:

a. CEMCO; California Expanded Metal Products Co.; FAS Track.
b. ClarkDietrich; BlazeFrame.
c. Fire Trak Corp; Fire Trak System attached to studs with Fire Trak Posi Klip.

F. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.

1. Minimum Base-Steel Thickness: 0.0329 inch.

G. Cold-Rolled Channel Bridging: Steel, 0.0538-inch minimum base-steel thickness, with minimum 1/2-inch-wide flanges.

1. Depth: 1-1/2 inches.
2. Clip Angle: Not less than 1-1/2 by 1-1/2 inches, 0.068-inch-thick, galvanized steel.

H. Hat-Shaped, Rigid Furring Channels: ASTM C645.

1. Minimum Base-Steel Thickness: 0.0179 inch.
2. Depth: 7/8 inch.

I. Resilient Furring Channels: 1/2-inch-deep, steel sheet members designed to reduce sound transmission.

1. Configuration: Asymmetrical.

J. Z-Shaped Furring: With slotted or nonslotted web, face flange of 1-1/4 inches, wall attachment flange of 7/8 inch, minimum uncoated-steel thickness of 0.0179 inch, and depth required to fit insulation thickness indicated.

2.3 SUSPENSION SYSTEMS

A. Tie Wire: ASTM A641/A641M, Class 1 zinc coating, soft temper, 0.062-inch-diameter wire, or double strand of 0.048-inch-diameter wire.

B. Hanger Attachments to Concrete:

1. Power-Actuated Anchors: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.

C. Wire Hangers: ASTM A641/A641M, Class 1 zinc coating, soft temper, 0.16 inch in diameter.

D. Carrying Channels (Main Runners): Cold-rolled, commercial-steel sheet with a base-steel thickness of 0.0538 inch and minimum 1/2-inch-wide flanges.

1. Depth: 1-1/2 inches.

E. Furring Channels (Furring Members):

1. Hat-Shaped, Rigid Furring Channels: ASTM C645, 7/8 inch deep.

a. Minimum Base-Steel Thickness: 0.0179 inch.

2. Resilient Furring Channels: 1/2-inch-deep members designed to reduce sound transmission.

a. Configuration: Asymmetrical.

F. Grid Suspension System for Gypsum Board Ceilings: ASTM C645, direct-hung system composed of main beams and cross-furring members that interlock.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Armstrong Ceiling & Wall Solutions; Drywall Grid Systems.
b. Certainteed; SAINT-GOBAIN; Grid Suspension System For Gypsum Board Ceilings.
c. Rockfon; ROCKWOOL International; Drywall Grid.
d. USG Corporation; Drywall Suspension System.

2.4 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards.

1. Fasteners for Steel Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.

B. Isolation Strip at Exterior Walls: Provide the following:

1. Foam Gasket: Adhesive-backed, closed-cell vinyl foam strips that allow fastener penetration without foam displacement, 1/8 inch thick, in width to suit steel stud size.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames, cast-in anchors, and structural framing, for compliance with requirements and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Suspended Assemblies: Coordinate installation of suspension systems with installation of overhead structure to ensure that inserts and other provisions for anchorages to building structure have been installed to receive hangers at spacing required to support the Work and that hangers will develop their full strength.

1. Furnish concrete inserts and other devices indicated to other trades for installation in advance of time needed for coordination and construction.

B. Coordination with Sprayed Fire-Resistive Materials:

1. Before sprayed fire-resistive materials are applied, attach offset anchor plates or ceiling tracks to surfaces indicated to receive sprayed fire-resistive materials. Where offset

anchor plates are required, provide continuous plates fastened to building structure not more than 24 inches o.c.

2. After sprayed fire-resistive materials are applied, remove them only to extent necessary for installation of non-load-bearing steel framing. Do not reduce thickness of fire-resistive materials below that are required for fire-resistance ratings indicated. Protect adjacent fire-resistive materials from damage.

3.3 INSTALLATION, GENERAL

A. Installation Standard: ASTM C754.

1. Gypsum Board Assemblies: Also comply with requirements in ASTM C840 that apply to framing installation.

B. Install framing and accessories plumb, square, and true to line, with connections securely fastened.

C. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.

D. Install bracing at terminations in assemblies.

E. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.

3.4 INSTALLING FRAMED ASSEMBLIES

A. Install framing system components of base-metal thickness and at spacing as determined by installer to comply with Part 2 Article “Performance Requirements” but not greater than spacings required by referenced installation standards for assembly types.

B. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.

C. Install studs so flanges within framing system point in same direction.

D. Install tracks at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts that penetrate partitions above ceiling.

1. Slip-Type Head Joints: Where framing extends to overhead structural supports, install to produce joints at tops of framing systems that prevent axial loading of finished assemblies.
2. Door Openings: Screw vertical studs at jambs to jamb anchor clips on door frames; install track section (for cripple studs) at head and secure to jamb studs.

    a. Install two studs at each jamb unless otherwise indicated.
    b. Install cripple studs at head adjacent to each jamb stud, with a minimum 1/2-inch clearance from jamb stud to allow for installation of control joint in finished assembly.

c. Extend jamb studs through suspended ceilings and attach to underside of overhead structure.

3. Other Framed Openings: Frame openings other than door openings the same as required for door openings unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.
4. Fire-Resistance-Rated Partitions: Install framing to comply with fire-resistance-rated assembly indicated and support closures and to make partitions continuous from floor to underside of solid structure.

   a. Firestop Track: Where indicated, install to maintain continuity of fire-resistance-rated assembly indicated.

5. Sound-Rated Partitions: Install framing to comply with sound-rated assembly indicated.
6. Curved Partitions:

   a. Bend track to uniform curve and locate straight lengths so they are tangent to arcs.
   b. Begin and end each arc with a stud, and space intermediate studs equally along arcs. On straight lengths of no fewer than two studs at ends of arcs, place studs 6 inches o.c.

E. Z-Shaped Furring Members:

1. Erect insulation, specified in Section 07 21 00 "Thermal Insulation," vertically and hold in place with Z-shaped furring members spaced 24 inches o.c.
2. Except at exterior corners, securely attach narrow flanges of furring members to wall with concrete stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches o.c.
3. At exterior corners, attach wide flange of furring members to wall with short flange extending beyond corner; on adjacent wall surface, screw-attach short flange of furring channel to web of attached channel. At interior corners, space second member no more than 12 inches from corner and cut insulation to fit.

F. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch from the plane formed by faces of adjacent framing.

3.5 INSTALLING CEILING SUSPENSION SYSTEMS

A. Install suspension system components of base-metal thickness and at spacing as determined by installer to comply with Part 2 Article “Performance Requirements” but not greater than spacings required by referenced installation standards for assembly types.

B. Isolate suspension systems from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement.

C. Suspend hangers from building structure as follows:

1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or suspension system.

   a. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.

2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with locations of hangers required to support standard suspension system members, install supplemental suspension members and hangers in the form of trapezes or equivalent devices.

    a. Size supplemental suspension members and hangers to support ceiling loads indicated in Part 2 Article “Performance Requirements” within performance limits established by referenced installation standards.

3. Wire Hangers: Secure by looping and wire tying, either directly to structures or to inserts, eye screws, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause hangers to deteriorate or otherwise fail.
4. Do not attach hangers to steel roof deck.
5. Do not attach hangers to permanent metal forms. Furnish cast-in-place hanger inserts that extend through forms.
6. Do not attach hangers to rolled-in hanger tabs of composite steel floor deck.
7. Do not connect or suspend steel framing from ducts, pipes, or conduit.

D. Fire-Resistance-Rated Assemblies: Wire tie furring channels to supports.

E. Grid Suspension Systems: Attach perimeter wall track or angle where grid suspension systems meet vertical surfaces. Mechanically join main beam and cross-furring members to each other and butt-cut to fit into wall track.

F. Installation Tolerances: Install suspension systems that are level to within 1/8 inch in 12 feet measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

END OF SECTION

SECTION 09 23 13 - ACOUSTICAL GYPSUM PLASTERING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes seamless acoustical plaster system at walls and ceilings.

B. Related Requirements:

1. Section 09 22 16 “Non-Structural Metal Framing” for metal framing supporting seamless acoustical plaster system.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include installation instructions, construction details, material descriptions, dimensions of individual components and profiles, and finishes for seamless acoustical plaster system.

B. Shop Drawings:

1. Include plans, sections, and details.
2. Indicate control joint locations, attachment details, and transition details to adjacent work

C. Samples for Verification: 12-inch square; for each type of exposed finish.

1.3 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Ceiling plan and wall elevations, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Non-structural metal framing.
2. Sprinklers.
3. Lights.
4. Speakers.
5. Other ceiling and wall mounted devices.

B. Qualification Data: For Installer.

C. Product Test Reports: For acoustical performance, according to ASTM C 423, performed by a qualified testing agency.

D. Sample Warranty: For manufacturer's warranty.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For acoustical plastering to include in maintenance manuals.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: A minimum of 5 years' experience in the manufacture and provision of acoustical plastering materials similar in type and scope to those required.

B. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

C. Mockups: Build mockups to set quality standards for materials and execution.

1. Build mockup of system, approximately 144 square feet, in location approved by Architect.
2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store materials in accordance with manufacturer's recommendations in a fully enclosed space protected against damage from moisture, direct sunlight, and surface contamination.

B. Protect base and top coat from freezing.

C. Allow materials to be acclimated to Project conditions before installation.

1.7 FIELD CONDITIONS

A. Do not install sound absorptive panels that are wet, moisture damaged, or mold damaged.

B. Environmental Limitations: Do not deliver or install seamless acoustical plaster system until spaces are enclosed and weathertight, work above ceilings is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

1. Do not apply finish coat when temperatures are below 55 degrees F.

C. Ventilation: Maintain adequate ventilation to remove excess moisture and promote drying of applied material.

1.8 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace installation that fails in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

    a. Cracking, flaking, excessive dusting, peeling, delamination from substrate or other deterioration such that material would not perform effectively as intended for a sound absorbent purpose.

2. Failures resulting from abuse or improper maintenance are not covered.
3. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Sound Absorption: NRC 0.65 minimum; ASTM C 423, E-400 mounting.

B. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: 25 or less.
2. Smoke-Developed Index: 450 or less.

2.2 SEAMLESS ACOUSTICAL PLASTER SYSTEM

A. Acoustical Plaster System: Acoustical plaster system composed of recycled crushed glass board, bonding and joint adhesive, fastened to rigid ceiling framing and coated with a sound-permeable base coat and smooth plaster top coat.

1. Basis-of-Design Product: Subject to compliance with requirements, provide **Pyrok, Inc.; StarSilent** or comparable product by one of the following:

    a. Baswa Acoustic North America; Baswa Phon.

2. Density: 1.8 lbs/cu ft according to ASTM E 605.
3. Compressive Strength: 125 psi according to ASTM E 761.
4. Substrate Board Thickness: 1 inch (25 mm) typical; 3/8 inch (10 mm) at curved surfaces.
5. Texture: Smooth.
6. Color: Custom color as indicated on Finish Schedule.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with manufacturer’s recommended installation requirements.

B. Framing and Substrate Tolerance: Not to exceed 1/32 inch in 4 feet.

C. Examine products before installation. Reject boards that are wet, moisture damaged, or mold damaged.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATION

A. Install acoustical plastering system according to manufacturer's written installation instructions.

B. Place control joints in locations indicated or, if not indicated, as approved by Architect not to exceed 1800 square feet in area with no edge greater than 60 feet long.

C. Fasten acoustical board panels to metal ceiling framing composed on 1-1/2-inch-deep cold rolled carrying channels at 4 feet on center maximum and 7/8-inch-deep, 0.0296-inch-thick, hat-shaped rigid furring channels spaced at 16 inches on center maximum.

D. Seal acoustical board panels to perimeter walls with foam tape, where applicable.

E. Apply manufacturer's proprietary adhesive to panel edges and over fasteners. Allow to dry completely overnight before proceeding.

F. Sand over fasteners and panel seams.

G. Apply base coat over entire panel surface; allow to dry 36 hours minimum.

H. Apply finish coat over entire surface and trowel to smooth plaster finish.

3.3 CLEANING AND PATCHING

A. Remove fall out material immediately upon completion of the work in each area.

B. Clean surfaces to remove evidence of soiling.

C. Repair or replace damaged work surfaces to acceptable conditions.

D. Coordinate work with other work to minimize damage to system resulting from subsequent work. Patch damaged areas or surfaces by patching procedures as required to provide acceptable results.

END OF SECTION

SECTION 09 24 00 - CEMENT PLASTERING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Metal lath.
2. Accessories.
3. Base-coat cement plaster.
4. Cement plaster finish coats.

1.2 ACTION SUBMITTALS

A. Product Data:

1. For each type of product.

B. Shop Drawings: Locations and installation of control and expansion joints, including plans, elevations, sections, and attachment details.

C. Samples for Verification: For each type of factory-prepared finish coat and for each color and finish texture specified, 12 by 12 inches, and prepared on rigid backing.

D. Sustainable Design Submittals:

1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.

1.3 MOCKUPS

A. Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.

1. Build mockups for each substrate and color and finish texture indicated for cement plastering, including accessories.

a. Size: 100 sq. ft. in surface area.

2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Owner specifically approves such deviations by Change Order.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.4 DELIVERY, STORAGE AND HANDLING

A. Store materials inside under cover, and keep them dry and protected against damage from weather, moisture, direct sunlight, surface contamination, corrosion, construction traffic, and other causes.

1.5 FIELD CONDITIONS

A. Comply with ASTM C926 requirements.

B. Exterior Plasterwork:

1. Apply and cure plaster to prevent plaster drying out during curing period. Use procedures required by climatic conditions, including moist curing, providing coverings, and providing barriers to deflect sunlight and wind.
2. Apply plaster when ambient temperature is greater than 40 deg F.
3. Protect plaster coats from freezing for not less than 48 hours after set of plaster coat has occurred.

C. Factory-Prepared Finish Coats: Comply with manufacturer's written instructions for environmental conditions for applying finish coats.

PART 2 - PRODUCTS

2.1 METAL LATH

A. Expanded Metal Lath: ASTM C847; cold-rolled carbon steel sheet, hot-dip galvanized with ASTM A653/A653M G90 zinc coating.

1. Recycled Content: Provide products with postconsumer recycled content plus one-half of preconsumer recycled content to the extent required to comply with the minimum criteria specified in Section 01 81 13.14 “Sustainable Design Requirements.”

2. Self-Furring Diamond-Mesh Lath:

a. Weight: 3.4 lb/sq. yd..

2.2 ACCESSORIES

A. General: Comply with requirements in ASTM C1063, and coordinate depth of trim and accessories with thicknesses and number of plaster coats required.

B. Metal Accessories:

1. Foundation Weep Screed: Fabricated from hot-dip-galvanized steel sheet with ASTM A653/A653M G90 zinc coating.
2. Cornerite: Fabricated from metal lath, hot-dip galvanized with ASTM A653/A653M G90 zinc coating.

3. Cornerbeads: Fabricated from zinc or zinc-coated (galvanized) steel.

    a. Smallnose cornerbead with expanded flanges; use unless otherwise indicated.

4. Casing Beads: Fabricated from zinc or zinc-coated (galvanized) steel; square-edged style; with expanded flanges.
5. Control Joints: Fabricated from zinc or zinc-coated (galvanized) steel; one-piece-type, folded pair of unperforated screeds in M-shaped configuration; with perforated flanges and removable protective tape on exposed face of control joint.

2.3 BASE-COAT CEMENT PLASTER

A. General: Comply with requirements in ASTM C926 for applications indicated.

1. Fiber Content: Add fiber to base-coat mixes after ingredients have mixed at least two minutes. Comply with fiber manufacturer's written instructions for fiber quantities in mixes, but do not exceed 1 lb of fiber/cu. yd. of cementitious materials.
2. Aggregate:

    a. Sand: Use unless otherwise indicated.

B. Base-Coat Mixes for Use over Metal Lath: Scratch and brown coats for three-coat plasterwork as follows:

1. Portland Cement Mixes:

    a. Scratch Coat: For cementitious material, mix 1 part portland cement and 3/4 to 1-1/2 parts lime. Use 2-1/2 to 4 parts aggregate per part of cementitious material.
    b. Brown Coat: For cementitious material, mix 1 part portland cement and 3/4 to 1-1/2 parts lime. Use 3 to 5 parts aggregate per part of cementitious material, but not less than volume of aggregate used in scratch coat.

2.4 CEMENT PLASTER FINISH COATS

A. Ready-Mixed Finish-Coat Plaster: Factory-mixed portland cement, aggregates, coloring agents, and proprietary ingredients.

1. Color: As selected by Architect from manufacturer's full range.
2. Source Limitations: Obtain ready-mixed finish-coat plaster from single source from single manufacturer.

2.5 PLASTER MATERIALS

A. Portland Cement: ASTM C150/C150M, Type I.

B. Lime: ASTM C206, Type S; or ASTM C207, Type S.

C. Sand Aggregate: ASTM C897.

2.6 MISCELLANEOUS MATERIALS

A. Water for Mixing and Finishing Plaster: Potable and free of substances capable of affecting plaster set or of damaging plaster, lath, or accessories.

B. Fiber for Base Coat: Alkaline-resistant glass or polypropylene fibers, 1/2 inch long, free of contaminants, manufactured for use in cement plaster.

C. Fasteners for Attaching Metal Lath to Substrates: ASTM C1063.

D. Wire: ASTM A641/A641M, Class 1 zinc coating, soft temper, not less than 0.0475-inch diameter unless otherwise indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Reject plaster materials that are wet or moisture damaged.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Protect adjacent work from soiling, spattering, moisture deterioration, and other harmful effects caused by plastering.

B. Prepare smooth, solid substrates for plaster in accordance with ASTM C926.

3.3 INSTALLATION OF METAL LATH

A. Metal Lath: Install in accordance with ASTM C1063.

3.4 INSTALLATION OF ACCESSORIES

A. Install in accordance with ASTM C1063 and at locations indicated on Drawings.

B. Reinforcement for External (Outside) Corners:

1. Install cornerbead at exterior locations.

C. Control Joints: Locate as approved by Architect for visual effect and as follows:

1. As required to delineate plasterwork into areas (panels) of the following maximum sizes:

a. Vertical Surfaces: 144 sq. ft..

2. At distances between control joints of not greater than 18 ft. o.c.
3. As required to delineate plasterwork into areas (panels) with length-to-width ratios of not greater than 2-1/2:1.
4. Where control joints occur in surface of construction directly behind plaster.

3.5 APPLICATION OF BASE-COAT CEMENT PLASTER

A. General: Comply with ASTM C926.

1. Install so that finished plaster surfaces will not deviate more than plus or minus 1/4 inch in 10 ft. from a true plane when measured by a 10-ft. straightedge placed on surface.
2. Install so finished plaster surfaces will be flush with metal frames and other built-in metal items or accessories that act as a plaster ground unless otherwise indicated. Where casing bead does not terminate plaster at metal frame, cut base coat free from metal frame before plaster sets.

B. Wall/Vertical Base Coats:

1. Three-Coat Plasterwork Over Metal Lath: Install base-coat mixes for use over metal lath to produce scratch and brown coats having 3/4-inch total thickness.

3.6 APPLICATION OF CEMENT PLASTER FINISH COATS

A. General: Comply with ASTM C926.

1. Do not deviate more than plus or minus 1/4 inch in 10 ft. from a true plane in finished plaster surfaces when measured by a 10-ft. straightedge placed on surface.
2. Finish plaster flush with metal frames and other built-in metal items or accessories that act as a plaster ground unless otherwise indicated. Where casing bead does not terminate plaster at metal frame, groove finish coat at junctures with metal.
3. Provide plaster surfaces that are ready to receive field-applied finishes indicated.

B. Plaster Finish Coats: Apply to provide float finish to match Architect's sample.

3.7 REPAIR

A. Repair or replace work to eliminate cracks, dents, blisters, buckles, crazing and check cracking, dry outs, efflorescence, sweat outs, and similar defects and where bond to substrate has failed.

3.8 CLEANING

A. Remove temporary protection and enclosure of other work after plastering is complete.

B. Promptly remove plaster from door frames, windows, and other surfaces not indicated to be plastered.

C. Repair floors, walls, roofs, and other surfaces stained, marred, or otherwise damaged during plastering.

END OF SECTION

SECTION 09 27 13 - GLASS-FIBER-REINFORCED GYPSUM FABRICATIONS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Glass-fiber-reinforced gypsum fabrications in configurations indicated and including producing molds to replicate existing plaster ceiling ornamentation in existing Historic Courtroom.

B. Related Requirements:

1. Section 06 83 13 “Fiber-Reinforced Plastic (FRP) Paneling” for exterior FRP fabrications.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, weights, dimensions of individual components and profiles, and finishes.

B. Sustainable Design Submittals:

1. Product Data: For adhesives, indicating VOC content.
2. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting materials.

C. Shop Drawings:

1. Include plans, elevations, sections, and attachment details, including locations of attachments for fabrications suspended by tie wires from structure.
2. Detail fabrication and assembly of glass-fiber-reinforced gypsum fabrications.
3. Indicate requirements for joint treatment.
4. Indicate location of control joints.

D. Samples: For each exposed product and for each color and texture specified.

1. Linear Moldings: 24-inch-long section minimum with finished joint. Show complete pattern.
2. Historic Ceiling Ornamentation: 1 full size casting of each replicated ceiling detail.

1.3 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with one another, using input from installers of the items involved:

1. Ceiling suspension system members.

2. Structural members to which glass-fiber-reinforced gypsum fabrications will be attached and method of attachment.
3. Items penetrating finished ceiling including the following:

    a. Lighting fixtures.
    b. Air outlets and inlets.
    c. Speakers.
    d. Sprinklers.
    e. Access panels.

4. Perimeter moldings.

1.4 MOCKUPS

A. Build mockups to set quality standards for fabrication and installation.

1. Build mockup of each type of glass-fiber-reinforced gypsum fabrication.
2. Paint mockups to match finish indicated and to comply with requirements specified in Section 099123 "Interior Painting."
3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Comply with ASTM C1467/C1467M.

1.6 FIELD CONDITIONS

A. Environmental Conditions:

1. Comply with ASTM C1467/C1467M.
2. Do not deliver or install glass-fiber-reinforced gypsum fabrications until building is enclosed, wet-work is complete, and HVAC system is operating and continuously maintaining temperature and relative humidity at levels intended for building occupants.

B. Conditioning: Acclimatize glass-fiber-reinforced gypsum fabrications to ambient temperature and humidity of spaces in which they will be installed. Remove packaging and move units into installation spaces not less than 48 hours before installing them.

PART 2 - PRODUCTS

2.1 GLASS-FIBER-REINFORCED GYPSUM FABRICATIONS

A. Fabrications: Molded, glass-fiber-reinforced gypsum units complying with ASTM C1381/C1381M.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

    a. Armstrong Ceiling & Wall Solutions.
    b. Formglas Products Ltd.
    c. Plasterform Inc.; Armstrong World Industries.
    d. Plastrglas, Incorporated.
    e. Stromberg Architectural Products, Inc.

B. Embedments: As standard with glass-fiber-reinforced gypsum fabrication manufacturer and as required for reinforcement and for anchorage to substrates and framing.

C. Finish: Smooth for paint finish.

2.2 AUXILIARY MATERIALS

A. Adhesives: As recommended in glass-fiber-reinforced gypsum fabrication manufacturer's written instructions.

1. Verify adhesives have a VOC content of 70 g/L or less.
2. Verify adhesive complies with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

B. Steel Drill Screws: ASTM C1002, unless otherwise indicated.

C. Joint-Treatment Materials: ASTM C475/C475M.

D. Control Joints: ASTM C1047, one-piece control joint with V-shaped slot and removable strip covering the slot opening.

1. Material: Rolled zinc.

E. Tie Wire: ASTM A641/A641M, Class 1 zinc coating, soft temper, 0.062-inch-diameter wire, or double strand of 0.048-inch-diameter wire.

2.3 FABRICATION

A. Fabricate glass-fiber-reinforced gypsum units in factory to comply with ASTM C1381/C1381M, with smooth-finished surfaces; repair hollows, voids, scratches, and other surface imperfections. Fabricate units in lengths and sizes that will minimize number of joints between abutting units.

B. Embedments: Incorporate embedments into units to develop the full strength of glass-fiber-reinforced gypsum fabrications. Cover embedments with not less than 3/16-inch thickness of glass-fiber-reinforced gypsum composite.

C. Connection Hardware: Designed and fabricated to support and connect glass-fiber-reinforced gypsum fabrications to hangers, support framing, and substrates.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with ASTM C1467/C1467M.

B. Install glass-fiber-reinforced gypsum fabrications level, plumb, true, and aligned with adjacent materials. Use concealed shims where required for alignment.

C. Attach glass-fiber-reinforced gypsum fabrications to framing and substrates with steel drill screws unless otherwise indicated. Do not use pneumatic staple guns. Countersink screw heads below adjoining finished surface.

1. Predrill fastener holes in units. Clean fastener holes to remove dirt and oil.
2. Locate fasteners not less than 5/16 inch from edges or ends of units.

D. Suspended Systems: Attach suspended glass-fiber-reinforced gypsum fabrications to structure with tie wire at each attachment point indicated on approved Shop Drawings. Comply with requirements for hangers specified in Section 092216 "Non-Structural Metal Framing."

E. Where glass-fiber-reinforced gypsum fabrications are joined to form composite units, join fabrications with adhesive. Band or brace units together until adhesive cures.

F. Install control joints between glass-fiber-reinforced gypsum fabrications where indicated.

G. Use joint-treatment materials to finish glass-fiber-reinforced gypsum fabrications to produce surfaces ready to receive primers and paint finishes specified in Section 099123 "Interior Painting."

1. Finish glass-fiber-reinforced gypsum fabrications according to ASTM C840 for Level 5 and to match surface texture of units.
2. Repair hollows, voids, scratches, and other surface imperfections on units.

END OF SECTION

SECTION 09 29 00 - GYPSUM BOARD

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Interior gypsum board.
2. Exterior gypsum board for ceilings and soffits.
3. Tile backing panels.

B. Related Requirements:

1. Section 06 16 00 "Sheathing" for gypsum sheathing for exterior walls.
2. Section 07 92 19 "Acoustical Joint Sealants" for acoustical joint sealants installed in gypsum board assemblies.
3. Section 09 21 16.23 "Gypsum Board Shaft Wall Assemblies" for metal shaft-wall framing, gypsum shaft liners, and other components of shaft-wall assemblies.
4. Section 09 22 16 "Non-Structural Metal Framing" for non-structural steel framing and suspension systems that support gypsum board panels.
5. Section 10 26 41 “Bullet Resistant Panels” for bullet resistant fiberglass armor panels installed in gypsum board assemblies.

1.2 ACTION SUBMITTALS

A. Product Data: For the following:

1. Gypsum board, Type X.
2. Impact-resistant gypsum board.
3. Mold-resistant gypsum board.
4. Glass-mat, water-resistant backing board.
5. Exterior gypsum soffit board.
6. Interior trim.
7. Exterior trim.
8. Aluminum trim.
9. Joint treatment materials.
10. Sound-attenuation blankets.

B. Shop Drawings: Show locations and installation of control and expansion joints, including plans, elevations, sections, details of components, and attachments to other work.

C. Samples for Verification: For the following products:
1. Trim Accessories: Full-size Sample in 12-inch-long length for each trim accessory indicated.

1.3 MOCKUPS

A. Build mockups of at least 500 sq. ft. in surface area to demonstrate aesthetic effects and to set quality standards for materials and execution.

1. Build mockups for the following:

a. Gypsum board Level 5 finish.

2. Apply or install final decoration indicated, including painting on exposed surfaces for review of mockups.
3. Simulate finished lighting conditions for review of mockups.
4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.4 DELIVERY, STORAGE AND HANDLING

A. Store materials inside under cover and keep them dry and protected against weather, condensation, direct sunlight, construction traffic, and other potential causes of damage. Stack panels flat and supported on risers on a flat platform to prevent sagging.

1.5 FIELD CONDITIONS

A. Environmental Limitations: Comply with ASTM C840 requirements or gypsum board manufacturer's written instructions, whichever are more stringent.

B. Do not install paper-faced gypsum panels until installation areas are enclosed and conditioned.

C. Do not install panels that are wet, moisture damaged, and mold damaged.

1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Obtain each type of gypsum panel and joint finishing material from single source with resources to provide products of consistent quality in appearance and physical properties.

2.2 PERFORMANCE REQUIREMENTS

A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E119 by an independent testing agency.

B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E90 and classified according to ASTM E413 by an independent testing agency.

C. Verify ceiling and wall materials comply with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

2.3 GYPSUM BOARD, GENERAL

A. Recycled Content: Provide products with postconsumer recycled content plus one-half of preconsumer recycled content to the extent required to comply with the minimum criteria specified in Section 01 81 13.14 “Sustainable Design Requirements.”

B. Regional Materials: To the extent required to comply with the minimum criteria specified in Section 01 81 13.14 “Sustainable Design Requirements,” manufacture products within 100 miles of Project site from materials that have been extracted, harvested, or recovered, as well as manufactured, within 100 miles of Project site.

C. Size: Provide maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

2.4 INTERIOR GYPSUM BOARD

A. Gypsum Board, Type X: ASTM C1396/C1396M.

1. Thickness: 5/8 inch.
2. Long Edges: Tapered.

B. Impact-Resistant Gypsum Board: ASTM C1396/C1396M gypsum board, tested according to ASTM C1629/C1629M.

1. Products: Subject to compliance with requirements, provide one of the following:

    a. American Gypsum; 5/8" M-Bloc® IR Type X with Mold & Moisture Resistance.
    b. Certainteed; SAINT-GOBAIN; CertainTeed Extreme Impact Resistant Type X Gypsum Board with M2Tech Mold and Moisture Technology.
    c. Gold Bond Building Products, LLC provided by National Gypsum Company; Gold Bond® XP® Hi-Impact® Gypsum Board.
    d. PABCO Gypsum; PABCO® Impact Resistant.
    e. USG Corporation; USG Sheetrock® Brand Mold Tough® VHI (Very High Impact) Firecode® Core.

2. Core: 5/8 inch, Type X.
3. Surface Abrasion: ASTM C1629/C1629M, meets or exceeds Level 3 requirements.
4. Indentation: ASTM C1629/C1629M, meets or exceeds Level 1 requirements.
5. Soft-Body Impact: ASTM C1629/C1629M, meets or exceeds Level 3 requirements.
6. Hard-Body Impact: ASTM C1629/C1629M, meets or exceeds Level 3 requirements according to test in Annex A1.
7. Long Edges: Tapered.
8. Mold Resistance: ASTM D3273, score of 10 as rated according to ASTM D3274.

C. Mold-Resistant Gypsum Board: ASTM C1396/C1396M. With moisture- and mold-resistant core and paper surfaces.

1. Core: 5/8 inch, Type X.
2. Long Edges: Tapered.
3. Mold Resistance: ASTM D3273, score of 10 as rated according to ASTM D3274.

2.5 EXTERIOR GYPSUM BOARD FOR CEILINGS AND SOFFITS

A. Glass-Mat Gypsum Sheathing Board: ASTM C1177/C1177M, with fiberglass mat laminated to both sides and with manufacturer's standard edges.

1. Products: Subject to compliance with requirements, provide one of the following:

a. American Gypsum; 5/8" M-GLASS® Type X Exterior Gypsum Sheathing.
b. Certainteed; SAINT-GOBAIN; GlasRoc Sheathing.
c. Georgia-Pacific Gypsum LLC.; DensGlass Sheathing.
d. Gold Bond Building Products, LLC provided by National Gypsum Company; Gold Bond® eXP® Fire-Shield® Sheathing.
e. PABCO Gypsum; PABCO GLASS® Sheathing.
f. USG Corporation; USG Securock® Brand UltraLight Glass-Mat Sheathing.

2. Core: 5/8 inch, Type X.

2.6 TILE BACKING PANELS

A. Glass-Mat, Water-Resistant Backing Board: ASTM C1178/C1178M, with manufacturer's standard edges.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Certainteed; SAINT-GOBAIN; GlasRoc Tile Backer.
b. Georgia-Pacific Gypsum LLC.; DensShield Tile Backer.
c. Gold Bond Building Products, LLC provided by National Gypsum Company; Gold Bond® eXP® Fire-Shield® Tile Backer.
d. USG Corporation; USG Durock™ Glass-Mat Tile Backerboard.

2. Core: 5/8 inch, Type X.
3. Mold Resistance: ASTM D3273, score of 10 as rated according to ASTM D3274.

2.7 TRIM ACCESSORIES

A. Interior Trim: ASTM C1047.

1. Material: Galvanized or aluminum-coated steel sheet or rolled zinc.
2. Shapes:

a. Cornerbead.
b. LC-Bead: J-shaped; exposed long flange receives joint compound.
c. Expansion (control) joint.

B. Exterior Trim: ASTM C1047.

1. Material: Hot-dip galvanized-steel sheet or rolled zinc.
2. Shapes:

a. Cornerbead.
b. LC-Bead: J-shaped; exposed long flange receives joint compound.
c. Expansion (Control) Joint: One-piece, rolled zinc with V-shaped slot and removable strip covering slot opening.

C. Aluminum Trim: Extruded accessories of profiles and dimensions indicated.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Fry Reglet Corporation.
b. Gordon Inc.
c. Pittcon Industries.

2. Aluminum: Alloy and temper with not less than the strength and durability properties of ASTM B221, Alloy 6063-T5.
3. Picture Rail:

a. Basis-of-Design Product: Subject to compliance with requirement, provide **Fry Reglet Corporation; Reveal/Picture Hanger DRMH-50** or comparable product by one of the following:

1) Gordon Inc.
2) Pittcon Industries.

b. Hanger Clips: Provide two (2) hanger clips for each 5 lineal feet for picture rail indicated on Drawings.

4. Finish: Corrosion-resistant primer compatible with joint compound and finish materials specified.

D. Partition Gap Closure:

1. Partition Gap Closure: Extruded aluminum, nested, spring-loaded, u-shaped channels to provide tight fit between the intersection of a gypsum board partition and glazed mullion.
2. Basis-of-Design Product: Subject to compliance with requirements, provide **Gordon Inc.; Mullion Mate Series 30 with MMEC End Cap** or comparable product by one of the following:

a. Fry Reglet Corporation.
b. Pittcon Industries.

2.8 JOINT TREATMENT MATERIALS

A. General: Comply with ASTM C475/C475M.

B. Joint Tape:

1. Interior Gypsum Board: Paper.
2. Glass-Mat Gypsum Sheathing Board: 10-by-10 glass mesh.
3. Tile Backing Panels: As recommended by panel manufacturer.

C. Joint Compound for Interior Gypsum Board: For each coat, use formulation that is compatible with other compounds applied on previous or for successive coats.

1. Prefilling: At open joints, rounded or beveled panel edges, and damaged surface areas, use setting-type taping compound.
2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use setting-type taping compound.
3. Fill Coat: For second coat, use setting-type, sandable topping compound.
4. Finish Coat: For third coat, use drying-type, all-purpose compound.
5. Skim Coat: For final coat of Level 5 finish, use drying-type, all-purpose compound.

D. Joint Compound for Exterior Applications:

1. Glass-Mat Gypsum Sheathing Board: As recommended by sheathing board manufacturer.

E. Joint Compound for Tile Backing Panels:

1. Glass-Mat, Water-Resistant Backing Panel: As recommended by backing panel manufacturer.

2.9 AUXILIARY MATERIALS

A. Provide auxiliary materials that comply with referenced installation standards and manufacturer's written instructions.

B. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.

1. Verify adhesives have a VOC content of 50 g/L or less.
2. Verify adhesive complies with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

C. Steel Drill Screws: ASTM C1002 unless otherwise indicated.

1. Use screws complying with ASTM C954 for fastening panels to steel members from 0.033 to 0.112 inch thick.

D. Sound-Attenuation Blankets: ASTM C665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.

1. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.
2. Recycled Content: Provide products with postconsumer recycled content plus one-half of preconsumer recycled content to the extent required to comply with the minimum criteria specified in Section 01 81 13.14 “Sustainable Design Requirements.”

E. Acoustical Sealant: As specified in Section 07 92 19 "Acoustical Joint Sealants."

1. Verify sealant has a VOC content of 250 g/L or less.
2. Verify sealant complies with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

F. Thermal Insulation: As specified in Section 07 21 00 "Thermal Insulation."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and substrates including welded hollow-metal frames and support framing, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.

B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION AND FINISHING OF PANELS, GENERAL

A. Comply with ASTM C840.

B. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.

C. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch of open space between panels. Do not force into place.

D. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.

E. Form control and expansion joints with space between edges of adjoining gypsum panels.

F. Cover both faces of support framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.

1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. in area.
2. Fit gypsum panels around ducts, pipes, and conduits.
3. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow 1/4- to 3/8-inch-wide joints to install sealant.

G. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments. Provide 1/4- to 1/2-inch-wide spaces at these locations and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.

H. Attachment to Steel Framing: Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.

I. STC-Rated Assemblies: Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C919 and with manufacturer's written instructions for locating edge trim and closing off sound-flanking paths around or through assemblies, including sealing partitions above acoustical ceilings.

J. Install sound attenuation blankets before installing gypsum panels unless blankets are readily installed after panels have been installed on one side.

3.3 INSTALLATION OF INTERIOR GYPSUM BOARD

A. Install interior gypsum board in the following locations:

1. Type X: All surfaces unless otherwise indicated.
2. Impact-Resistant Type: As indicated on Drawings.
3. Mold-Resistant Type: Interior surfaces of exterior wall framing, unless wall is indicated to receive tile and on bathroom walls not scheduled to receive ceramic tile.

B. Single-Layer Application:
1. On ceilings, apply gypsum panels before wall/partition board application to greatest extent possible and at right angles to framing unless otherwise indicated.
2. On partitions/walls, apply gypsum panels vertically (parallel to framing) unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints.
    a. Stagger abutting end joints not less than one framing member in alternate courses of panels.
    b. At stairwells and other high walls, install panels horizontally unless otherwise indicated or required by fire-resistance-rated assembly.
3. On Z-shaped furring members, apply gypsum panels vertically (parallel to framing) with no end joints. Locate edge joints over furring members.
4. Fastening Methods: Apply gypsum panels to supports with steel drill screws.

C. Multilayer Application:

1. On ceilings, apply gypsum board indicated for base layers before applying base layers on walls/partitions; apply face layers in same sequence. Apply base layers at right angles to framing members and offset face-layer joints one framing member, 16 inches minimum, from parallel base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly.
2. On partitions/walls, apply gypsum board indicated for base layers and face layers vertically (parallel to framing) with joints of base layers located over stud or furring member and face-layer joints offset at least one stud or furring member with base-layer joints unless otherwise indicated or required by fire-resistance-rated assembly. Stagger joints on opposite sides of partitions.

3. On Z-shaped furring members, apply base layer vertically (parallel to framing) and face layer either vertically (parallel to framing) or horizontally (perpendicular to framing) with vertical joints offset at least one furring member. Locate edge joints of base layer over furring members.
4. Fastening Methods: Fasten base layers and face layers separately to supports with screws.

D. Curved Surfaces:

1. Install panels horizontally (perpendicular to supports) and unbroken, to extent possible, across curved surface plus 12-inch-long straight sections at ends of curves and tangent to them.
2. For double-layer construction, fasten base layer to studs with screws 16 inches o.c. Center gypsum board face layer over joints in base layer, and fasten to studs with screws spaced 12 inches o.c.

3.4 INSTALLATION OF EXTERIOR GYPSUM PANELS FOR CEILINGS AND SOFFITS

A. Apply panels perpendicular to supports, with end joints staggered and located over supports.

1. Install with 1/4-inch open space where panels abut other construction or structural penetrations.
2. Fasten with corrosion-resistant screws.

3.5 INSTALLATION OF TILE BACKING PANELS

A. Glass-Mat, Water-Resistant Backing Panels: Comply with manufacturer's written installation instructions and install at locations indicated to receive tile. Install with 1/4-inch gap where panels abut other construction or penetrations.

B. Where tile backing panels abut other types of panels in same plane, shim surfaces to produce a uniform plane across panel surfaces.

3.6 INSTALLATION OF TRIM ACCESSORIES

A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.

B. Control Joints: Install control joints at locations indicated on Drawings and where not specifically indicated according to ASTM C840 in locations approved by Architect for visual effect.

C. Interior Trim: Install in the following locations:

1. Cornerbead: Use at outside corners.
2. LC-Bead: Use at exposed panel edges.

D. Exterior Trim: Install in the following locations:

1. Cornerbead: Use at outside corners.

2. LC-Bead: Use at exposed panel edges.

E. Aluminum Trim: Install in locations indicated on Drawings.

3.7 FINISHING OF GYPSUM BOARD

A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.

B. Prefill open joints, rounded or beveled edges, and damaged surface areas.

C. Apply joint tape over gypsum board joints, except for trim products specifically indicated as not intended to receive tape.

D. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C840:

1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
2. Level 2: Panels that are substrate for tile.
3. Level 3: Not used.
4. Level 4: At panel surfaces to receive wall coverings.

    a. Primer and its application to surfaces are specified in Section 09 91 23 "Interior Painting."

5. Level 5: At all panel surfaces that will be exposed to view and receive paint finish unless otherwise indicated.

    a. Achieve Level 5 finish by application of a full skim coat of trowel-applied joint compound to the entire surface. Notwithstanding ASTM C 840 definition, the use of an alternative skim coat material manufactured for this purpose is not permitted.
    b. Primer and its application to surfaces are specified in Section 09 91 23 "Interior Painting."

E. Glass-Mat Gypsum Sheathing Board: Finish according to manufacturer's written instructions for use as exposed soffit board.

3.8 PROTECTION

A. Protect adjacent surfaces from drywall compound and promptly remove from floors and other non-drywall surfaces. Repair surfaces stained, marred, or otherwise damaged during drywall application.

B. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.

C. Remove and replace panels that are wet, moisture damaged, and mold damaged.

1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.

2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION

This page is intentionally left blank.

SECTION 09 30 13 - CERAMIC TILING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Ceramic, porcelain, and glazed tile.
2. Thresholds.
3. Waterproof membranes.
4. Crack isolation membranes.

B. Related Requirements:

1. Section 079200 "Joint Sealants" for sealing of expansion, contraction, control, and isolation joints in tile surfaces.
2. Section 092900 "Gypsum Board" for glass-mat, water-resistant backer board.

1.2 DEFINITIONS

A. General: Definitions in the ANSI A108 series of tile installation standards and in ANSI A137.1 apply to Work of this Section unless otherwise specified.

B. Face Size: Actual tile size, excluding spacer lugs.

C. Module Size: Actual tile size plus joint width indicated.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:

1. Product Data: For adhesives, indicating VOC content.
2. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting materials.
3. Laboratory Test Reports: For sealers, indicating compliance with requirements for low-emitting materials.

C. Samples for Verification:

1. Full-size units of each type and composition of tile and for each color and finish required.
2. Full-size units of each type of trim and accessory.
3. Metal edge strips in 6-inch lengths.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match and are from same production runs as products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Tile and Trim Units: Furnish quantity of full-size units equal to 3 percent of amount installed for each type, composition, color, pattern, and size indicated.
2. Grout: Furnish quantity of grout equal to 3 percent of amount installed for each type, composition, and color indicated.

1.6 QUALITY ASSURANCE

A. Installer Qualifications:

1. Installer employs at least one installer for Project that has completed the Advanced Certification for Tile Installers (ACT) certification for installation of membranes, shower receptors, and large format tile.

B. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Build mockup of each type of floor tile installation.
2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use. Comply with requirements in ANSI A137.1 for labeling tile packages.

B. Store tile and cementitious materials on elevated platforms, under cover, and in a dry location.

C. Store aggregates where grading and other required characteristics can be maintained and contamination can be avoided.

D. Store liquid materials in unopened containers and protected from freezing.

1.8 FIELD CONDITIONS

A. Environmental Limitations: Do not install tile until construction in spaces is complete and ambient temperature and humidity conditions are maintained at the levels indicated in referenced standards and manufacturer's written instructions.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations for Tile: Obtain tile of each type and color or finish from single source or producer.

1. Obtain tile of each type and color or finish from same production run and of consistent quality in appearance and physical properties for each contiguous area.

B. Source Limitations for Setting and Grouting Materials: Obtain ingredients of a uniform quality for each mortar, adhesive, and grout component from single manufacturer and each aggregate from single source or producer.

1. Obtain setting and grouting materials, except for unmodified Portland cement and aggregate, from single manufacturer.

C. Source Limitations for Other Products: Obtain each of the following products specified in this Section from a single manufacturer:

1. Waterproof membrane.
2. Crack isolation membrane.

2.2 PRODUCTS, GENERAL

A. ANSI Ceramic Tile Standard: Provide tile that complies with ANSI A137.1 for types, compositions, and other characteristics indicated.

B. ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI A108.02, ANSI standards referenced in other Part 2 articles, ANSI standards referenced by TCNA installation methods specified in tile installation schedules, and other requirements specified.

C. Factory Blending: For tile exhibiting color variations within ranges, blend tile in factory and package so tile units taken from one package show same range in colors as those taken from other packages and match approved Samples.

D. Mounting: For factory-mounted tile, provide back- or edge-mounted tile assemblies as standard with manufacturer unless otherwise indicated.

2.3 TILE PRODUCTS

A. Material Selection and Properties: As preselected and indicated in the Finish Schedule on the Drawings.

2.4 WATERPROOF MEMBRANES

A. General: Manufacturer's standard product that complies with ANSI A118.10 and is recommended by the manufacturer for the application indicated. Include reinforcement and accessories recommended by manufacturer.

B. Waterproof Membrane, Chlorinated Polyethylene Sheet: Nonplasticized, chlorinated polyethylene faced on both sides with nonwoven polyester fabric.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to the following:

a. Noble Company (The); NobelSeal TS.

2. Nominal Thickness: 0.030 inch.

2.5 CRACK ISOLATION MEMBRANES

A. General: Manufacturer's standard product that complies with ANSI A118.12 for high performance and is recommended by the manufacturer for the application indicated. Include reinforcement and accessories recommended by manufacturer.

B. Crack Isolation Membrane, Chlorinated Polyethylene Sheet: Nonplasticized, chlorinated polyethylene faced on both sides with nonwoven polyester fabric; 0.030-inch nominal thickness.

1. Products: Subject to compliance with requirements, provide the following or comparable product:

a. Noble Company (The); Nobleseal CIS.

2. Nominal Thickness: 0.030 inch.

2.6 SETTING MATERIALS

A. Medium-Bed, Modified Dry-Set Mortar: Comply with requirements in ANSI A118.4. Provide product that is approved by manufacturer for application thickness of 5/8 inch.

1. Basis-of-Design Product: Subject to compliance with requirements, provide **MAPEI Corporation; Ultraflex™ LFT** or a comparable product by one of the following:

a. ARDEX Americas.
b. Bostik, Inc.
c. Custom Building Products.
d. H.B. Fuller Construction Products Inc. / TEC.
e. LATICRETE SUPERCAP, LLC.

B. Improved Modified Dry-Set Mortar (Thinset): ANSI A118.15.

1. Basis-of-Design Product: Subject to compliance with requirements, provide **MAPEI Corporation; Granirapid® System** or a comparable product by one of the following:

a. ARDEX Americas.
b. Custom Building Products.
c. H.B. Fuller Construction Products Inc. / TEC.
d. LATICRETE SUPERCAP, LLC.

2. For wall applications, provide mortar that complies with requirements for nonsagging mortar in addition to the other requirements in ANSI A118.15.

2.7 GROUT MATERIALS

A. High-Performance Tile Grout: ANSI A118.7.

1. Basis-of-Design Product: Subject to compliance with requirements, provide **MAPEI Corporation; Ultracolor® Plus** or a comparable product by one of the following:

a. ARDEX Americas.
b. Bostik, Inc.
c. Custom Building Products.
d. H.B. Fuller Construction Products Inc. / TEC.
e. LATICRETE SUPERCAP, LLC.

2.8 MISCELLANEOUS MATERIALS

A. Trowelable Underlayments and Patching Compounds: Latex-modified, portland cement-based formulation provided or approved by manufacturer of tile-setting materials for installations indicated.

B. Metal Edge Strips: Angle or L-shaped, height to match tile and setting-bed thickness, metallic or combination of metal and PVC or neoprene base, designed specifically for flooring applications.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following or comparable product:

a. Blanke Corporation.
b. Schluter Systems L.P.

2. Configuration: As indicated on Drawings.
3. Exposed-edge material: As preselected and indicated in the Finish Schedule on the Drawings.

C. Metal Cove Base: Cove-shaped base, height to match tile and setting-bed thickness, metallic, designed specifically for flooring applications.

1. Basis-of-Design Product: Subject to compliance with requirement, provide **Schluter Systems L.P.; DILEX** or comparable product by one of the following:

a. Blanke Corporation.

2. Configuration: As indicated on Drawings.

D. Metal Tile Corner Guard: J-shaped with return, height to match tile and setting-bed thickness, metallic corner, designed specifically for wall applications.

1. Basis-of-Design Product: Subject to compliance with requirement, provide **Schluter Systems L.P.; QUADREC** or comparable product by one of the following:

a. Blanke Corporation.

2. Configuration: As indicated on Drawings.
3. Exposed-edge material: Stainless steel.

E. Tile Cleaner: A neutral cleaner capable of removing soil and residue without harming tile and grout surfaces, specifically approved for materials and installations indicated by tile and grout manufacturers.

F. Floor Sealer: Manufacturer's standard product for sealing grout joints and that does not change color or appearance of grout.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Bonsal American, an Oldcastle company.
b. Custom Building Products.
c. Jamo Inc.
d. Southern Grouts & Mortars, Inc.
e. Summitville Tiles, Inc.

2.9 MIXING MORTARS AND GROUT

A. Mix mortars and grouts to comply with referenced standards and mortar and grout manufacturers' written instructions.

B. Add materials, water, and additives in accurate proportions.

C. Obtain and use type of mixing equipment, mixer speeds, mixing containers, mixing time, and other procedures to produce mortars and grouts of uniform quality with optimum performance characteristics for installations indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions where tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

1. Verify that substrates for setting tile are firm; dry; clean; free of coatings that are incompatible with tile-setting materials, including curing compounds and other substances that contain soap, wax, oil, or silicone; and comply with flatness tolerances required by ANSI A108.01 for installations indicated.

2. Verify that concrete substrates for tile floors installed with thinset mortar comply with surface finish requirements in ANSI A108.01 for installations indicated.

    a. Verify that surfaces that received a steel trowel finish have been mechanically scarified.
    b. Verify that protrusions, bumps, and ridges have been removed by sanding or grinding.

3. Verify that installation of grounds, anchors, recessed frames, electrical and mechanical units of work, and similar items located in or behind tile has been completed.
4. Verify that joints and cracks in tile substrates are coordinated with tile joint locations; if not coordinated, adjust joint locations in consultation with Architect.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Fill cracks, holes, and depressions in concrete substrates for tile floors installed with thinset mortar with trowelable leveling and patching compound specifically recommended by tile-setting material manufacturer.

B. Where indicated, prepare substrates to receive waterproof membrane by applying a reinforced mortar bed that complies with ANSI A108.1A and is sloped 1/4 inch per foot toward drains.

C. Blending: For tile exhibiting color variations, verify that tile has been factory blended and packaged so tile units taken from one package show same range of colors as those taken from other packages and match approved Samples. If not factory blended, either return to manufacturer or blend tiles at Project site before installing.

3.3 INSTALLATION OF CERAMIC TILE

A. Comply with TCNA's "Handbook for Ceramic, Glass, and Stone Tile Installation" for TCNA installation methods specified in tile installation schedules. Comply with parts of the ANSI A108 series "Specifications for Installation of Ceramic Tile" that are referenced in TCNA installation methods, specified in tile installation schedules, and apply to types of setting and grouting materials used.

1. For the following installations, follow procedures in the ANSI A108 series of tile installation standards for providing 95 percent mortar coverage:

    a. Tile floors in wet areas.
    b. Tile floors consisting of tiles 8 by 8 inches or larger.

B. Extend tile work into recesses and under or behind equipment and fixtures to form complete covering without interruptions unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.

C. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile.

D. Provide manufacturer's standard trim shapes where necessary to eliminate exposed tile edges.

E. Jointing Pattern: Lay tile in grid pattern unless otherwise indicated. Lay out tile work and center tile fields in both directions in each space or on each wall area. Lay out tile work to minimize the use of pieces that are less than half of a tile. Provide uniform joint widths unless otherwise indicated.

1. Where adjoining tiles on floor, base, walls, or trim are specified or indicated to be same size, align joints.
2. Where tiles are specified or indicated to be whole integer multiples of adjoining tiles on floor, base, walls, or trim, align joints unless otherwise indicated.

F. Joint Widths: Unless otherwise indicated, install tile with the following joint widths:

1. Porcelain Tile: 1/8 inch.

G. Lay out tile wainscots to dimensions indicated or to next full tile beyond dimensions indicated.

H. Expansion Joints: Provide expansion joints and other sealant-filled joints, including control, contraction, and isolation joints, where indicated. Form joints during installation of setting materials, mortar beds, and tile. Do not saw-cut joints after installing tiles.

I. Stone Thresholds: Install stone thresholds in same type of setting bed as adjacent floor unless otherwise indicated.

1. Do not extend waterproof membrane or crack isolation membrane under thresholds set in improved modified dry-set mortar. Fill joints between such thresholds and adjoining tile set on waterproof membrane or crack isolation membrane with elastomeric sealant.

J. Metal Edge Strips: Install at locations indicated and where exposed edge of tile flooring meets carpet, wood, or other flooring that finishes flush with or below top of tile and no threshold is indicated.

3.4 INSTALLATION OF WATERPROOF MEMBRANES

A. Install waterproof membrane to comply with ANSI A108.13 and manufacturer's written instructions to produce waterproof membrane of uniform thickness that is bonded securely to substrate.

B. Allow waterproof membrane to cure and verify by testing that it is watertight before installing tile or setting materials over it.

3.5 INSTALLATION OF CRACK ISOLATION MEMBRANES

A. Install crack isolation membrane to comply with ANSI A108.17 and manufacturer's written instructions to produce membrane of uniform thickness that is bonded securely to substrate.

B. Allow crack isolation membrane to cure before installing tile or setting materials over it.

3.6 ADJUSTING AND CLEANING

A. Remove and replace tile that is damaged or that does not match adjoining tile. Provide new matching units, installed as specified and in a manner to eliminate evidence of replacement.

B. Cleaning: On completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign matter.

1. Remove grout residue from tile as soon as possible.
2. Clean grout smears and haze from tile according to tile and grout manufacturer's written instructions but no sooner than 10 days after installation. Use only cleaners recommended by tile and grout manufacturers and only after determining that cleaners are safe to use by testing on samples of tile and other surfaces to be cleaned. Protect metal surfaces and plumbing fixtures from effects of cleaning. Flush surfaces with clean water before and after cleaning.

3.7 PROTECTION

A. Protect installed tile work with kraft paper or other heavy covering during construction period to prevent staining, damage, and wear. If recommended by tile manufacturer, apply coat of neutral protective cleaner to completed tile walls and floors.

B. Prohibit foot and wheel traffic from tiled floors for at least seven days after grouting is completed.

C. Before final inspection, remove protective coverings and rinse neutral protective cleaner from tile surfaces.

3.8 INTERIOR CERAMIC TILE INSTALLATION SCHEDULE

A. Interior Floor Installations, Concrete Subfloor:

1. Ceramic Tile Installation: TCNA F125-Full; thinset mortar on crack isolation membrane at slab-on-grade.

    a. Location: Typical unless noted otherwise.
    b. Ceramic Tile Type: As indicated.
    c. Thinset Mortar: Improved modified dry-set mortar; medium-bed, modified dry-set at LFT.
    d. Grout: High-performance sanded or high-performance unsanded grout based on joint width.

        1) Color: As preselected and indicated in Finish Schedule.

2. Ceramic Tile Installation: TCNA F122A; thinset mortar on waterproof membrane at elevated slab-on-deck.

    a. Location: Typical unless noted otherwise.
    b. Ceramic Tile Type: As indicated.
    c. Thinset Mortar: Improved modified dry-set mortar; medium-bed, modified dry-set at LFT.
    d. Grout: High-performance sanded or high-performance unsanded grout based on joint width.

1) Color: As preselected and indicated in Finish Schedule.

B. Interior Wall Installations, Metal Studs:

1. Ceramic Tile Installation: TCNA W245 or TCNA W248; thinset mortar on glass-mat, water-resistant gypsum backer board.

a. Location: Typical unless noted otherwise.
b. Ceramic Tile Type: As indicated.
c. Thinset Mortar: Improved modified dry-set mortar.
d. Grout: High-performance sanded or high-performance unsanded grout based on joint width.

C. Shower Wall Installations, Metal Studs:

1. TCNA B419: Thinset mortar on coated glass-mat, water-resistant gypsum backer board.

a. Ceramic Tile Type: As indicated.
b. Thinset Mortar: Improved modified dry-set mortar.
c. Grout: High-performance sanded or high-performance unsanded grout based on joint width.

D. Shower Receptor and Wall Installations:

1. TCNA B420: Thinset mortar on waterproof membrane over coated glass-mat, water-resistant gypsum backer board.

a. Ceramic Tile Type: As indicated.
b. Thinset Mortar: Improved modified dry-set mortar.
c. Grout: High-performance sanded or high-performance unsanded grout based on joint width.

END OF SECTION

SECTION 09 51 13 - ACOUSTICAL PANEL CEILINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes acoustical panels and exposed suspension systems for interior ceilings.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:

1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.
2. Laboratory Test Reports: For ceiling products, indicating compliance with requirements for low-emitting materials.

C. Samples for Verification: For each component indicated and for each exposed finish required, prepared on Samples of sizes indicated below:

1. Acoustical Panels: Set of 6-inch-square Samples of each type, color, pattern, and texture.
2. Exposed Suspension-System Members, Moldings, and Trim: Set of 6-inch-long Samples of each type, finish, and color.

1.3 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Ceiling suspension-system members.
2. Structural members to which suspension systems will be attached.
3. Method of attaching hangers to building structure.
4. Carrying channels or other supplemental support for hanger-wire attachment where conditions do not permit installation of hanger wires at required spacing.
5. Size and location of initial access modules for acoustical panels.
6. Items penetrating finished ceiling and ceiling-mounted items including the following:

    a. Lighting fixtures.
    b. Diffusers.
    c. Grilles.
    d. Speakers.
    e. Sprinklers.
    f. Access panels.
    g. Perimeter moldings.

7. Minimum Drawing Scale: 1/4 inch = 1 foot.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For finishes to include in maintenance manuals.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Acoustical Ceiling Units: Full-size panels equal to 2 percent of quantity installed.
2. Suspension-System Components: Quantity of each exposed component equal to 2 percent of quantity installed.

1.6 QUALITY ASSURANCE

A. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.

1. Build 400 sq. ft. mockup of each typical ceiling area.
2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver acoustical panels, suspension-system components, and accessories to Project site and store them in a fully enclosed, conditioned space where they will be protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.

B. Before installing acoustical panels, permit them to reach room temperature and a stabilized moisture content.

1.8 FIELD CONDITIONS

A. Environmental Limitations: Do not install acoustical panel ceilings until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

1. Pressurized Plenums: Operate ventilation system for not less than 48 hours before beginning acoustical panel ceiling installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain each type of acoustical ceiling panel and its supporting suspension system from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Verify ceiling products comply with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

B. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: Class A according to ASTM E1264.
2. Smoke-Developed Index: 50 or less.

2.3 ACOUSTICAL PANELS AC-1, AC-2

A. Basis-of-Design Product: Subject to compliance with requirements, provide **Rockfon (Rockwool International); Rockfon Sonar** or comparable product by one of the following:

1. Armstrong Ceiling & Wall Solutions.
2. USG Corporation.

B. Acoustical Panel Standard: Provide manufacturer's standard panels according to ASTM E1264 and designated by type, form, pattern, acoustical rating, and light reflectance unless otherwise indicated.

C. Recycled Content: Provide products with postconsumer recycled content plus one-half of preconsumer recycled content to the extent required to comply with the minimum criteria specified in Section 01 81 13.14 “Sustainable Design Requirements.”

D. Classification: Provide panels as follows:

1. Type and Form: Type XX, high-density, ceramic- and mineral-base panels with scrubbable finish, resistant to heat, moisture, and corrosive fumes.
2. Pattern: E (lightly textured).

E. Color: As preselected and indicated in Finish Schedule.

F. Light Reflectance (LR): Not less than 0.85.

G. Noise Reduction Coefficient (NRC): Not less than 0.95.

H. Articulation Class (AC): Not less than 190.

I. Edge/Joint Detail: Square tegular narrow.

J. Thickness: 1 inch.

K. Modular Size: As indicated in the Finish Schedule.

2.4 ACOUSTICAL PANELS AC-3

A. Basis-of-Design Product: Subject to compliance with requirements, provide **Rockfon (Rockwool International); Rockfon Koral** or comparable product by one of the following:

1. Armstrong Ceiling & Wall Solutions.
2. USG Corporation.

B. Acoustical Panel Standard: Provide manufacturer's standard panels according to ASTM E1264 and designated by type, form, pattern, acoustical rating, and light reflectance unless otherwise indicated.

C. Recycled Content: Provide products with postconsumer recycled content plus one-half of preconsumer recycled content to the extent required to comply with the minimum criteria specified in Section 01 81 13.14 “Sustainable Design Requirements.”

D. Classification: Provide panels as follows:

1. Type and Form: Type XX, high-density, ceramic- and mineral-base panels with scrubbable finish, resistant to heat, moisture, and corrosive fumes.
2. Pattern: E (lightly textured).

E. Color: As preselected and indicated in Finish Schedule.

F. Light Reflectance (LR): Not less than 0.86.

G. Noise Reduction Coefficient (NRC): Not less than 0.85.

H. Articulation Class (AC): Not less than 170.

I. Edge/Joint Detail: Square.

J. Thickness: 5/8 inches.

K. Modular Size: 24 by 48 inches.

2.5 METAL SUSPENSION SYSTEM AC-1, AC-2

A. Basis-of-Design Product: Subject to compliance with requirements, provide **Rockfon (Rockwool International); Chicago Metallic 4200 Integrity** or comparable product by one of the following:

1. Armstrong Ceiling & Wall Solutions.
2. USG Corporation.

B. Metal Suspension-System Standard: Provide manufacturer's standard, direct-hung, metal suspension system and accessories according to ASTM C635/C635M and designated by type, structural classification, and finish indicated.

C. Recycled Content: Provide products with postconsumer recycled content plus one-half of preconsumer recycled content to the extent required to comply with the minimum criteria specified in Section 01 81 13.14 “Sustainable Design Requirements.”

D. Narrow-Face, Uncapped, Double-Web, Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet; prepainted, electrolytically zinc coated, or hot-dip galvanized, G30 coating designation; to produce structural members with 9/16-inch-wide faces.

1. Structural Classification: Intermediate-duty system.
2. Face Design: Flanges formed in stepped design with a center protrusion projecting 19/64 inch below flange surfaces supporting panel faces and forming 3/16-inch-wide reveals between edges of protrusion and those of panels.
3. Face Finish: Painted white.

2.6 METAL SUSPENSION SYSTEM AC-3

A. Basis-of-Design Product: Subject to compliance with requirements, provide **Rockfon (Rockwool International); 200 Snap Grid** or comparable product by one of the following:

1. Armstrong Ceiling & Wall Solutions.
2. Certainteed; SAINT-GOBAIN.
3. USG Corporation.

B. Metal Suspension-System Standard: Provide manufacturer's standard, direct-hung, metal suspension system and accessories according to ASTM C635/C635M and designated by type, structural classification, and finish indicated.

C. Recycled Content: Provide products with postconsumer recycled content plus one-half of preconsumer recycled content to the extent required to comply with the minimum criteria specified in Section 01 81 13.14 “Sustainable Design Requirements.”

D. Wide-Face, Capped, Double-Web, Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet; prepainted, electrolytically zinc coated, or hot-dip galvanized, G30 coating designation; with prefinished 15/16-inch-wide metal caps on flanges.

1. Structural Classification: Intermediate-duty system.
2. End Condition of Cross Runners: Override (stepped) or butt-edge type.
3. Face Design: Flat, flush.
4. Cap Material: Cold-rolled steel.
5. Cap Finish: Painted in color as selected from manufacturer's full range.

2.7 ACCESSORIES

A. Attachment Devices: Size for five times the design load indicated in ASTM C635/C635M, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.

1. Anchors in Concrete: Anchors of type and material indicated below, with holes or loops for attaching hangers of type indicated and with capability to sustain, without failure, a load equal to five times that imposed by ceiling construction, as determined by testing according to ASTM E488/E488M or ASTM E1512 as applicable, conducted by a qualified testing and inspecting agency.

    a. Type: Postinstalled expansion anchors.
    b. Corrosion Protection: Carbon-steel components zinc plated according to ASTM B633, Class SC 1 (mild) service condition.

2. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hangers of type indicated and with capability to sustain, without failure, a load equal to 10 times that imposed by ceiling construction, as determined by testing according to ASTM E1190, conducted by a qualified testing and inspecting agency.

B. Wire Hangers, Braces, and Ties: Provide wires as follows:

1. Zinc-Coated, Carbon-Steel Wire: ASTM A641/A641M, Class 1 zinc coating, soft temper.
2. Size: Wire diameter sufficient for its stress at three times hanger design load (ASTM C635/C635M, Table 1, "Direct Hung") will be less than yield stress of wire, but not less than 0.106-inch-diameter wire.

2.8 ACOUSTICAL SEALANT

A. Acoustical Sealant: As specified in Section 07 92 19 "Acoustical Joint Sealants."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, including structural framing to which acoustical panel ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage and with requirements for installation tolerances and other conditions affecting performance of acoustical panel ceilings.

B. Examine acoustical panels before installation. Reject acoustical panels that are wet, moisture damaged, or mold damaged.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders unless otherwise indicated, and comply with layout shown on reflected ceiling plans.

B. Layout openings for penetrations centered on the penetrating items.

3.3 INSTALLATION

A. Install acoustical panel ceilings according to ASTM C636/C636M and manufacturer's written instructions.

B. Suspend ceiling hangers from building's structural members and as follows:

1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
2. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
3. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension-system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices.
4. Secure wire hangers to ceiling-suspension members and to supports above with a minimum of three tight turns. Connect hangers directly to structure or to inserts, eye screws, or other devices that are secure and appropriate for substrate and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
5. Do not support ceilings directly from permanent metal forms or floor deck. Fasten hangers to cast-in-place hanger inserts, postinstalled mechanical or adhesive anchors, or power-actuated fasteners that extend through forms into concrete.
6. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.
7. Do not attach hangers to steel deck tabs.
8. Do not attach hangers to steel roof deck. Attach hangers to structural members.
9. Space hangers not more than 48 inches o.c. along each member supported directly from hangers unless otherwise indicated; provide hangers not more than 8 inches from ends of each member.
10. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards.

C. Secure bracing wires to ceiling suspension members and to supports with a minimum of four tight turns. Suspend bracing from building's structural members as required for hangers, without attaching to permanent metal forms, steel deck, or steel deck tabs. Fasten bracing wires into concrete with cast-in-place or postinstalled anchors.

D. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels.

1. Apply acoustical sealant in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.
2. Screw attach moldings to substrate at intervals not more than 16 inches o.c. and not more than 3 inches from ends. Miter corners accurately and connect securely.
3. Do not use exposed fasteners, including pop rivets, on moldings and trim.

E. Install suspension-system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.

F. Install acoustical panels with undamaged edges and fit accurately into suspension-system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide precise fit.

1. Arrange directionally patterned acoustical panels as follows:

a. Install panels with pattern running in one direction parallel to long axis of space.

2. For square-edged panels, install panels with edges fully hidden from view by flanges of suspension-system runners and moldings.
3. For reveal-edged panels on suspension-system runners, install panels with bottom of reveal in firm contact with top surface of runner flanges.
4. Paint cut edges of panel remaining exposed after installation; match color of exposed panel surfaces using coating recommended in writing for this purpose by acoustical panel manufacturer.
5. Install hold-down clips in garage; space according to panel manufacturer's written instructions unless otherwise indicated.

a. Hold-Down Clips: Space 24 inches o.c. on all cross runners.

3.4 ERECTION TOLERANCES

A. Suspended Ceilings: Install main and cross runners level to a tolerance of 1/8 inch in 12 feet, non-cumulative.

B. Moldings and Trim: Install moldings and trim to substrate and level with ceiling suspension system to a tolerance of 1/8 inch in 12 feet, non-cumulative.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Perform the following tests and inspections of completed installations of acoustical panel ceiling hangers and anchors and fasteners in successive stages and when installation of ceiling suspension systems on each floor has reached 20 percent completion, but no panels have been installed. Do not proceed with installations of acoustical panel ceiling hangers for the next area until test results for previously completed installations of acoustical panel ceiling hangers show compliance with requirements.

1. Within each test area, testing agency will select one of every 10 power-actuated fasteners and postinstalled anchors used to attach hangers to concrete and will test them for 200 lbf of tension; it will also select one of every two postinstalled anchors used to attach bracing wires to concrete and will test them for 440 lbf of tension.
2. When testing discovers fasteners and anchors that do not comply with requirements, testing agency will test those anchors not previously tested until 20 pass consecutively and then will resume initial testing frequency.

C. Acoustical panel ceiling hangers, anchors, and fasteners will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

3.6 CLEANING

A. Clean exposed surfaces of acoustical panel ceilings, including trim, edge moldings, and suspension-system members. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage.

B. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION

This page is intentionally left blank.

SECTION 09 64 00 - WOOD FLOORING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Factory-finished wood flooring.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:

1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.
2. Chain-of-Custody Certificates: For certified wood products. Include statement of costs.
3. Chain-of-Custody Qualification Data: For manufacturer and vendor.
4. Product Data: For adhesives, indicating VOC content.
5. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting materials.
6. Product Data: For coatings, indicating VOC content.
7. Laboratory Test Reports: For coatings, indicating compliance with requirements for low-emitting materials.
8. Laboratory Test Reports: For flooring products, indicating compliance with requirements for low-emitting materials.
9. Laboratory Test Reports: For composite wood products, indicating compliance with requirements for low-emitting materials.

C. Shop Drawings: For each type of floor assembly and accessory. Include plans, sections, and attachment details. Include expansion provisions and trim details.

D. Samples for Verification: For each type of wood flooring and accessory, with stain color and finish required, approximately 12 inches long and of same thickness and material indicated for the Work and showing the full range of normal color and texture variations expected.

1.3 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Wood Flooring: Equal to 1 percent of amount installed for each type, color, and finish of wood flooring indicated.

1.4 QUALITY ASSURANCE

A. Certified Wood: Provide an invoice including vendor's chain-of-custody number, product cost, and entity being invoiced.

B. Vendor Qualifications: A vendor that is certified for chain of custody by an FSC-accredited certification body.

1.5 MOCKUPS

A. Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.

1. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver wood flooring materials in unopened cartons or bundles.

B. Protect wood flooring from exposure to moisture. Do not deliver wood flooring until after concrete, masonry, plaster, ceramic tile, and similar wet-work is complete and dry.

C. Store wood flooring materials in a dry, warm, ventilated, weathertight location.

1.7 FIELD CONDITIONS

A. Conditioning period begins not less than seven days before wood flooring installation, is continuous through installation, and continues not less than seven days after wood flooring installation.

1. Environmental Conditioning: Maintain ambient temperature between 65 and 75 deg F and relative humidity planned for building occupants in spaces to receive wood flooring during the conditioning period.
2. Wood Flooring Conditioning: Move wood flooring into spaces where it will be installed, no later than the beginning of the conditioning period.

a. Do not install flooring until it adjusts to relative humidity of, and is at same temperature as, space where it is to be installed.
b. Open sealed packages to allow wood flooring to acclimatize immediately on moving flooring into spaces in which it will be installed.

B. After conditioning period, maintain relative humidity and ambient temperature planned for building occupants.

C. Install factory-finished wood flooring after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Verify flooring products comply with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

B. Certified Wood: Certify wood products as "FSC Pure" or "FSC Mixed Credit" in accordance with FSC STD-01-001 and FSC STD-40-004.

C. Composite Wood Products: Verify products are made using ultra-low-emitting formaldehyde resins, as defined in the California Air Resources Board's "Airborne Toxic Control Measure to Reduce Formaldehyde Emissions from Composite Wood Products," or are made with no added formaldehyde.

2.2 FACTORY-FINISHED WOOD FLOORING

A. Engineered-Wood Flooring, Factory-Finished: HPVA EF, complying with requirements for composite wood products.

1. Basis-of-Design Product: Subject to compliance with requirements, provide **Nydree Flooring; Nydree Engineered Acrylic Infused Hardwood Flooring** or a comparable product by one of the following:

    a. Anderson Tuftex.
    b. Boen.
    c. Bruce Hardwood; AHF Products.
    d. Carlisle Wide Plank Floors.
    e. Johnsonite; a Tarkett company.
    f. Mannington Mills, Inc.
    g. Oregon Lumber Company.

2. Species: As preselected and indicated in Finish Schedule.
3. Thickness: 0.441 inch.
4. Construction: 7-ply marine-grade Baltic Birch plywood
5. Face Width: As indicated on Finish Schedule.
6. Length: Manufacturer's standard.
7. Edge Style: Square.
8. Finish: Acrylic impregnated.

    a. Color: As preselected and indicated in Finish Schedule.

2.3 ACCESSORY MATERIALS

A. Wood Flooring Adhesive: Mastic recommended by flooring and adhesive manufacturers for application indicated.

1. Verify adhesive has a VOC content of 100 g/L or less.

2. Verify adhesive complies with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

B. Trowelable Leveling and Patching Compound: Latex-modified, hydraulic-cement-based formulation approved by wood flooring manufacturer.

C. Thresholds and Saddles: To match wood flooring. Tapered on each side.

D. Reducer Strips: To match wood flooring. 2 inches wide, tapered, and in thickness required to match height of flooring.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for maximum moisture content, installation tolerances, and other conditions affecting performance of wood flooring.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

C. Concrete Slabs: Verify that concrete substrates are dry and moisture-vapor emissions are within acceptable levels according to manufacturer's written instructions.

1. Moisture Testing: Perform tests so that each test area does not exceed 1000 sq. ft., and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.

    a. Anhydrous Calcium Chloride Test: ASTM F1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 4.5 lb of water/1000 sq. ft. in 24 hours.
    b. Relative Humidity Test: Using in situ probes, ASTM F2170. Proceed with installation only after substrates have a maximum 80 percent relative humidity level measurement.
    c. Perform additional moisture tests recommended by manufacturer. Proceed with installation only after substrates pass testing.

3.2 PREPARATION

A. Concrete Slabs:

1. Grind high spots and fill low spots to produce a maximum 1/8-inch deviation in any direction when checked with a 10-foot straight edge.
2. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, and depressions in substrates.
3. Remove coatings, including curing compounds, and other substances on substrates that are incompatible with installation adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.

B. Broom or vacuum clean substrates to be covered immediately before product installation. After cleaning, examine substrates for moisture, alkaline salts, carbonation, or dust. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 INSTALLATION

A. Comply with flooring manufacturer's written installation instructions, but not less than applicable recommendations in NWFA's "Installation Guidelines."

B. Provide expansion space at walls and other obstructions and terminations of flooring as recommended by manufacturer.

C. Engineered-Wood Flooring: Set in adhesive.

3.4 PROTECTION

A. Protect installed wood flooring during remainder of construction period with covering of heavy kraft paper or other suitable material. Do not use plastic sheet or film that might cause condensation.

1. Do not move heavy and sharp objects directly over kraft-paper-covered wood flooring. Protect flooring with plywood or hardboard panels to prevent damage from storing or moving objects over flooring.

END OF SECTION

This page is intentionally left blank.

SECTION 09 65 13 - RESILIENT BASE AND ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Thermoset-rubber base.
2. Thermoplastic-rubber base.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:

1. Product Data: For adhesives, indicating VOC content.
2. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting materials.
3. Product Data: For sealants, indicating VOC content.
4. Laboratory Test Reports: For sealants, indicating compliance with requirements for low-emitting materials.
5. Laboratory Test Reports: For resilient base and stair products and accessories, indicating compliance with requirements for low-emitting materials.
6. Environmental Product Declaration: For each product.
7. Health Product Declaration: For each product.
8. Sourcing of Raw Materials: Corporate sustainability report for each manufacturer.

C. Samples for Verification: For each type of product indicated and for each color, texture, and pattern required in manufacturer's standard-size Samples, but not less than 12 inches long.

1.3 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Furnish not less than 10 linear feet for every 500 linear feet or fraction thereof, of each type, color, pattern, and size of resilient product installed.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Store resilient products and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F or more than 90 deg F.

1.5 FIELD CONDITIONS

A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F or more than 95 deg F, in spaces to receive resilient products during the following periods:

1. 48 hours before installation.
2. During installation.
3. 48 hours after installation.

B. After installation and until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F or more than 95 deg F.

C. Install resilient products after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Verify products comply with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

2.2 THERMOSET-RUBBER BASE

A. Basis-of-Design Product: Subject to compliance with requirements, provide **Johnsonite; a Tarkett company; Baseworks** or a comparable product by one of the following:

1. Flexco.
2. Roppe Corporation.

B. Product Standard: ASTM F1861, Type TS (rubber, vulcanized thermoset), Group I (solid, homogeneous).

1. Style and Location: Unless noted otherwise, provide the following:

a. Style A, Straight: Provide in areas with carpet.
b. Style B, Cove: Provide in areas with hard surface floor coverings.

C. Thickness: 0.125 inch.

D. Height: 4 inches, unless noted otherwise.

E. Lengths: Coils in manufacturer's standard length.

F. Outside Corners: Preformed.

G. Inside Corners: Preformed.

H. Colors: As preselected and indicated in Finish Schedule.

2.3 THERMOPLASTIC-RUBBER BASE

A. Basis-of-Design Product: Subject to compliance with requirements, provide **Johnsonite; a Tarkett company; Millwork** or a comparable product by one of the following:

1. Flexco.
2. Roppe Corporation.

3. Group: I (solid, homogeneous).
4. Style and Location:

a. Style D, Sculptured: Provide in areas indicated.

1) Profile: Reveal.

B. Thickness: 0.375 inch.

C. Height: 6 inch.

D. Lengths: Cut lengths 96 inches long.

E. Outside Corners: Preformed.

F. Inside Corners: Preformed.

G. Colors: As preselected and indicated in Finish Schedule.

2.4 RUBBER MOLDING ACCESSORY

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Flexco; Roppe Holding Company.
2. Tarkett.
3. Roppe Corporation; Roppe Holding Company.

B. Description: Rubber reducer strip for resilient floor covering, joiner for tile and carpet, transition strips and as indicated.

C. Profile and Dimensions: As indicated.

D. Colors and Patterns: As preselected and indicated in Finish Schedule.

2.5 INSTALLATION MATERIALS

A. Trowelable Leveling and Patching Compounds: Latex-modified, portland-cement-based or blended hydraulic-cement-based formulation provided or approved by resilient-product manufacturer for applications indicated.

B. Adhesives: Water-resistant type recommended by resilient-product manufacturer for resilient products and substrate conditions indicated.

1. Verify adhesives have a VOC content of 50 g/L or less.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

1. Installation of resilient products indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.

B. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.

C. Do not install resilient products until materials are the same temperature as space where they are to be installed.

1. At least 48 hours in advance of installation, move resilient products and installation materials into spaces where they will be installed.

D. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient products.

3.3 RESILIENT BASE INSTALLATION

A. Comply with manufacturer's written instructions for installing resilient base.

B. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.

C. Install resilient base in lengths as long as practical without gaps at seams and with tops of adjacent pieces aligned.

D. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.

E. Do not stretch resilient base during installation.

F. Preformed Corners: Install preformed corners before installing straight pieces.

3.4 RESILIENT ACCESSORY INSTALLATION

A. Comply with manufacturer's written instructions for installing resilient accessories.

B. Resilient Molding Accessories: Butt to adjacent materials and tightly adhere to substrates throughout length of each piece. Install reducer strips at edges of floor covering that would otherwise be exposed.

3.5 CLEANING AND PROTECTION

A. Comply with manufacturer's written instructions for cleaning and protecting resilient products.

B. Perform the following operations immediately after completing resilient-product installation:

1. Remove adhesive and other blemishes from surfaces.

C. Protect resilient products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.

D. Cover resilient products subject to wear and foot traffic until Substantial Completion.

END OF SECTION

This page is intentionally left blank.

SECTION 09 65 19 - RESILIENT TILE FLOORING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Vinyl composition floor tile.
2. Luxury vinyl tile.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:

1. Product Data: For adhesives, indicating VOC content.
2. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting materials.
3. Laboratory Test Reports: For chemical-bonding compounds, indicating compliance with requirements for low-emitting materials.
4. Product Data: For sealants, indicating VOC content.
5. Laboratory Test Reports: For sealants, indicating compliance with requirements for low-emitting materials.
6. Laboratory Test Reports: For flooring products, indicating compliance with requirements for low-emitting materials.
7. Environmental Product Declaration: For each product.
8. Health Product Declaration: For each product.
9. Sourcing of Raw Materials: Corporate sustainability report for each manufacturer.

C. Samples for Verification: Full-size units of each color and pattern of floor tile required.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For each type of floor tile to include in maintenance manuals.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Floor Tile: Furnish one box for every 50 boxes or fraction thereof, of each type, color, and pattern of floor tile installed.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are competent in techniques required by manufacturer for floor tile installation and seaming method indicated.

1. Engage an installer who employs workers for this Project who are trained or certified by floor tile manufacturer for installation techniques required.

B. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.

1. Coordinate mockups in this Section with mockups specified in other Sections.

a. Size: Minimum 100 sq. ft. for each type, color, and pattern in locations directed by Architect.

2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store floor tile and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F or more than 90 deg F. Store floor tiles on flat surfaces.

1.8 FIELD CONDITIONS

A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F or more than 95 deg F, in spaces to receive floor tile during the following periods:

1. 48 hours before installation.
2. During installation.
3. 48 hours after installation.

B. After installation and until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F or more than 95 deg F.

C. Close spaces to traffic during floor tile installation.

D. Close spaces to traffic for 48 hours after floor tile installation.

E. Install floor tile after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics: For resilient floor tile, as determined by testing identical products according to ASTM E648 or NFPA 253 by a qualified testing agency.

1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

B. Verify flooring products comply with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

2.2 VINYL COMPOSITION FLOOR TILE

A. Basis-of-Design Product: Subject to compliance with requirements, provide **Johnsonite; a Tarkett company Azterra** or comparable product by one of the following:

1. Armstrong Flooring, Inc.
2. Congoleum Flooring.

B. Tile Standard: ASTM F1066, Class 2, through pattern.

C. Wearing Surface: Smooth.

D. Thickness: 0.125 inch.

E. Size: 12 by 12 inches.

F. Colors and Patterns: As preselected and indicated in Finish Schedule.

2.3 LUXURY VINYL FLOOR TILE

A. Luxury Vinyl Tile: Subject to compliance with requirement provide products by one of the following:

1. Basis-of-Design Product: Subject to compliance with requirement, provide **Mannington Commercial; Amtico Spacia 5mm** or comparable product:

a. Armstrong Flooring.
b. Floor & Décor.
c. Interface.
d. Mannington Commercial.
e. Milliken.
f. Mohawk.
g. Patcraft, a division of Shaw Industries.
h. Tarkett.

B. Tile Standard: ASTM F1700.

1. Class: Class III, Printed Film Vinyl Tile.
2. Type: A, Smooth Surface.

C. Critical Radian Flux: Class I, Pass; ASTM E648

D. Construction: Composed of a non-skid backing, a high vinyl content backing layer, glass fiber reinforcing layer, high vinyl content core layer, printed film layer, transparent wear layer and a polyurethane coating.

E. Wear Layer Thickness: 0.020 inch (0.55 mm).

F. Overall Thickness: 0.197 inch (5.0 mm).

G. Size: As preselected and indicated in Finish Schedule.

H. Colors and Patterns: As preselected and indicated in Finish Schedule.

2.4 INSTALLATION MATERIALS

A. Trowelable Leveling and Patching Compounds: Latex-modified, portland-cement-based or blended hydraulic-cement-based formulation provided or approved by floor tile manufacturer for applications indicated.

B. Adhesives: Water-resistant type recommended by floor tile and adhesive manufacturers to suit floor tile and substrate conditions indicated.

1. Verify adhesives have a VOC content of 50 g/L or less.
2. Verify adhesive complies with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of floor tile.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Prepare substrates according to floor tile manufacturer's written instructions to ensure adhesion of resilient products.

B. Concrete Substrates: Prepare according to ASTM F710.

1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by floor tile manufacturer. Do not use solvents.
3. Alkalinity and Adhesion Testing: Perform tests recommended by floor tile manufacturer. Proceed with installation only after substrate alkalinity falls within range on pH scale recommended by manufacturer in writing, but not less than 5 or more than 9 pH.
4. Moisture Testing: Perform tests so that each test area does not exceed 1000 sq. ft., and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.

    a. Anhydrous Calcium Chloride Test: ASTM F1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. in 24 hours.
    b. Relative Humidity Test: Using in-situ probes, ASTM F2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement.

C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.

D. Do not install floor tiles until materials are the same temperature as space where they are to be installed.

1. At least 48 hours in advance of installation, move resilient floor tile and installation materials into spaces where they will be installed.

E. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient floor tile.

3.3 FLOOR TILE INSTALLATION

A. Comply with manufacturer's written instructions for installing floor tile.

B. Lay out floor tiles from center marks established with principal walls, discounting minor offsets, so tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half tile at perimeter.

1. Lay tiles square with room axis.

C. Match floor tiles for color and pattern by selecting tiles from cartons in the same sequence as manufactured and packaged, if so numbered. Discard broken, cracked, chipped, or deformed tiles.

1. Lay tiles with grain running as directed by Architect.

D. Scribe, cut, and fit floor tiles to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, and door frames.

E. Extend floor tiles into toe spaces, door reveals, closets, and similar openings. Extend floor tiles to center of door openings.

F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on floor tiles as marked on substrates. Use chalk or other nonpermanent marking device.

G. Adhere floor tiles to substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

3.4 CLEANING AND PROTECTION

A. Comply with manufacturer's written instructions for cleaning and protecting floor tile.

B. Perform the following operations immediately after completing floor tile installation:

1. Remove adhesive and other blemishes from surfaces.
2. Sweep and vacuum surfaces thoroughly.
3. Damp-mop surfaces to remove marks and soil.

C. Protect floor tile from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.

D. Cover floor tile until Substantial Completion.

END OF SECTION

SECTION 09 65 36 - STATIC-CONTROL RESILIENT FLOORING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Static-control, vinyl composition floor tile.

B. Related Requirements:

1. Section 09 65 13 "Resilient Base and Accessories" for resilient base, reducer strips, and other accessories installed with static-control resilient flooring.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:

1. Product Data: For adhesives, indicating VOC content.
2. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting materials.
3. Product Data: For chemical-bonding compounds, indicating VOC content.
4. Laboratory Test Reports: For chemical-bonding compounds, indicating compliance with requirements for low-emitting materials.
5. Laboratory Test Reports: For flooring products, indicating compliance with requirements for low-emitting materials.

C. Shop Drawings: For each type of static-control resilient flooring.

1. Show locations of inscribed maintenance floor tiles in conductive, solid vinyl floor tile installation areas.
2. Show grounding locations of grounding strips and connections.

D. Samples for Verification: For each type of static-control resilient flooring and in each color, pattern, and texture required, of size indicated below:

1. Floor Tile: 6-by-9-inch units.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Test Reports: For static-control resilient flooring, for tests performed by a qualified testing agency.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For each type of static-control resilient flooring to include in maintenance manuals.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Floor Tile: Furnish one box for every 50 boxes, or fraction thereof, of each type, color, and pattern of floor tile installed.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer who employs workers for this Project who are competent in installation techniques required by manufacturer for specified static-control resilient flooring.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store static-control resilient flooring and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended in writing by manufacturer, but not less than 50 deg F or more than 90 deg F.

1. Floor Tile: Store on flat surfaces.

1.8 PROJECT CONDITIONS

A. Maintain ambient temperatures in spaces to receive static-control resilient flooring within range recommended by manufacturer, but not less than 70 deg F or more than 85 deg F, during the following time periods:

1. Period recommended in writing by manufacturer before installation.
2. During installation.
3. Period recommended in writing by manufacturer after installation.

B. Until Substantial Completion, maintain ambient temperatures in installation areas within range recommended by manufacturer, but not less than 55 deg F or more than 95 deg F.

C. Close spaces to traffic during static-control resilient flooring installation.

D. Close spaces to traffic for period recommended in writing by manufacturer after static-control resilient flooring installation.

E. Install static-control resilient flooring after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Verify flooring products comply with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

2.2 STATIC-CONTROL, SOLID VINYL FLOOR TILE

A. Basis-of-Design Product: Subject to compliance with requirements, provide **Johnsonite; a Tarkett company; iQ Granit SD** or a comparable product by one of the following:

1. Flexco.
2. Forbo Flooring Systems.
3. Roppe Corporation.
4. VPI Corporation.

B. Source Limitations: Obtain floor tile from single source from single manufacturer.

C. Static-Control Properties: As determined by testing identical products in accordance with test method indicated by an independent testing and inspecting agency.
1. Electrical Resistance: Test per ESD-STM-7.1.

a. Average greater than 1 megohm and less than or equal to 1000 megohms when test specimens are tested surface to ground.

2. Static Generation: Less than 300 V when tested per AATCC-134 at 20 percent relative humidity with conductive footwear.
3. Static Decay: 5000 to zero V in less than 0.25 seconds when tested per FED-STD-101C/4046.1.

D. Critical Radiant Flux: 0.45 W/sq. cm or greater when tested in accordance with ASTM E648 or NFPA 253.

E. Construction: ASTM F1700, Class I (monolithic), Type A (smooth surface).

F. Thickness: Manufacturer's standard, but not less than 0.08 inch.

G. Size: 24 by 24 inches.

H. Colors and Patterns: As preselected and indicated in Finish Schedule.

2.3 INSTALLATION MATERIALS

A. Trowelable Leveling and Patching Compounds: Latex-modified portland cement or blended hydraulic-cement-based formulation provided or approved by manufacturer for applications indicated.

B. Static-Control Adhesive: Provided or approved by manufacturer; type that maintains electrical continuity of floor-covering system to ground connection.

1. Verify adhesives have a VOC content of 60 g/L or less.
2. Verify adhesive complies with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

C. Grounding Strips: Provided or approved by manufacturer; type and size that maintains electrical continuity of floor-covering system to ground connection.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer and manufacturer's representative present, for compliance with requirements for conditions affecting performance of the Work.

B. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with installation or static-control characteristics of floor coverings.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Prepare substrates in accordance with manufacturer's written instructions and with oversight by manufacturer's representative to ensure successful installation of static-control resilient flooring and electrical continuity of floor-covering systems.

B. Concrete Substrates: Prepare in accordance with ASTM F710.

1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
2. Remove substrate coatings and other substances that are incompatible with floor-covering adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
3. Alkalinity and Adhesion Testing: Perform tests recommended in writing by manufacturer. Proceed with installation only after substrate alkalinity is not less than 6 or more than 8 pH unless otherwise recommended in writing by flooring manufacturer.
4. Moisture Testing: Perform tests so that each test area does not exceed 1000 sq. ft., and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.

    a. Anhydrous Calcium Chloride Test: ASTM F1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. in 24 hours.
    b. Relative Humidity Test: Using in-situ probes, ASTM F2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement.

C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound and remove bumps and ridges to produce a uniform and smooth substrate.

D. Do not install static-control resilient flooring until it is same temperature as space where it is to be installed.

1. Move static-control resilient flooring and installation materials into spaces where they will be installed at least 48 hours in advance of installation.

E. Sweep and vacuum substrates to be covered by static-control resilient flooring immediately before installation.

3.3 INSTALLATION, GENERAL

A. Install static-control resilient flooring in accordance with manufacturer's written instructions and with oversight by manufacturer's representative.

B. Extend grounding strips beyond perimeter of static-control resilient floor-covering surfaces to ground connections.

1. For adhesively installed flooring, embed grounding strips in static-control adhesive.

C. Scribe, cut, and fit static-control resilient flooring to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, and door frames.

1. Extend static-control resilient flooring below built-in items and permanent, but movable, items that allow for a flexible layout where indicated on Drawings.

D. Extend static-control resilient flooring into toe spaces, door reveals, closets, and similar openings.

E. Extend static-control resilient flooring to center of door openings where flooring or color transitions occur.

F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on static-control resilient flooring as marked on substrates. Use chalk or other nonpermanent, nonstaining marking device.

G. Adhesive Installation: Adhere static-control resilient flooring to substrates using a full spread of static-control adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

3.4 INSTALLATION OF FLOOR TILE

A. Lay out floor tiles from center marks established with principal walls, discounting minor offsets, so floor tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half floor tile at perimeter.

1. Lay floor tiles square with room axis.

B. Match floor tiles for color and pattern by selecting floor tiles from cartons in same sequence as manufactured and packaged if so numbered. Discard broken, cracked, chipped, or deformed floor tiles.

C. In each space where conductive, solid vinyl floor tile is installed, install maintenance floor tile identifying conductive floor tile in locations approved by Architect.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to test electrical resistance of static-control resilient flooring in accordance with ASTM F150 or ESD STM7.1 for compliance with requirements.

1. Arrange for testing after the following:

   a. Static-control adhesives have fully cured.
   b. Static-control resilient flooring has stabilized to ambient conditions.
   c. Ground connections are completed.

B. Static-control resilient flooring will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.6 CLEANING AND PROTECTION

A. Comply with manufacturer's written instructions for cleaning and protection of static-control resilient flooring.

B. Perform the following operations immediately after completing static-control resilient flooring:

1. Remove static-control adhesive from exposed surfaces.
2. Remove dirt and blemishes from exposed surfaces.
3. Sweep and vacuum surfaces thoroughly.
4. Damp-mop surfaces to remove marks and soil.

C. Protect static-control resilient flooring from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.

1. Do not wax static-control resilient flooring.

D. Cover static-control resilient flooring and protect from rolling loads until Substantial Completion.

END OF SECTION

SECTION 09 65 66 - RESILIENT ATHLETIC FLOORING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Rubber floor tile.

B. Related Requirements:

1. Section 096513 "Resilient Base and Accessories" for wall base and accessories installed with resilient athletic flooring.

1.2 COORDINATION

A. Coordinate layout and installation of flooring with floor inserts for gymnasium equipment.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:

1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.
2. Product Data: For adhesives, indicating VOC content.
3. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting materials.
4. Laboratory Test Reports: For flooring products, indicating compliance with requirements for low-emitting materials.

C. Shop Drawings: Show installation details and locations of the following:

1. Floor patterns.
2. Locations of floor inserts for athletic equipment installed through flooring.

D. Samples for Verification: For each type, color, and pattern of flooring specified, 12-inch- square in size and of same thickness and material indicated for the Work.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For resilient athletic flooring to include in maintenance manuals.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Floor Tile: Furnish no fewer than 1 box for each 50 boxes or fraction thereof, of each type, color, pattern, and size of floor tile installed.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in original packages and containers, with seals unbroken, bearing manufacturer's labels indicating brand name and directions for storing.

B. Store materials to prevent deterioration.

1. Store tiles on flat surfaces.

1.7 FIELD CONDITIONS

A. Adhesively Applied Products:

1. Maintain temperatures during installation within range recommended in writing by manufacturer, but not less than 70 deg F or more than 95 deg F, in spaces to receive flooring 48 hours before installation, during installation, and 48 hours after installation unless longer period is recommended in writing by manufacturer.
2. After postinstallation period, maintain temperatures within range recommended in writing by manufacturer, but not less than 55 deg F or more than 95 deg F.
3. Close spaces to traffic during flooring installation.
4. Close spaces to traffic for 48 hours after flooring installation unless manufacturer recommends longer period in writing.

B. Install flooring after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Verify flooring products comply with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

2.2 RUBBER FLOOR TILE RF-1

A. Basis-of-Design Product: Subject to compliance with requirements, provide **Tarkett Sports; a division of the Tarkett Group; Triumph Rubber Multi-functional and Sports Floor Tiles** or a comparable product by one of the following:

1. Flexco.
2. Roppe Corporation.
3. Sport Court, a Gerflor Company.

B. Description: Athletic flooring consisting of modular rubber tiles with smooth edges for adhered application.

C. Material: Rubber.

1. Recycled Content: Provide products with postconsumer recycled content plus one-half of preconsumer recycled content to the extent required to comply with the minimum criteria specified in Section 01 81 13.33 “Sustainable Design Requirements – IGCC/ASHRAE 189.1.”

D. Traffic-Surface Texture: Textured.

E. Size: 24 inches square.

F. Thickness: 3/8 inch.

G. Weight: Not less than 13.3 per tile.

H. Color and Pattern: As preselected and indicated in Finish Schedule.

2.3 ACCESSORIES

A. Trowelable Leveling and Patching Compound: Latex-modified, hydraulic-cement-based formulation approved by flooring manufacturer.

B. Adhesives: Water-resistant type recommended in writing by manufacturer for substrate and conditions indicated.

1. Verify adhesives have a VOC content of 60 g/L or less.
2. Verify adhesive complies with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements for installation tolerances, moisture content, and other conditions affecting performance of the Work.

1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of flooring.

B. Concrete Substrates: Prepare according to ASTM F710.

1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
2. Alkalinity Testing: Perform pH testing according to ASTM F710. Proceed with installation only if pH readings are not less than 7.0 and not greater than 8.5.
3. Moisture Testing: Perform tests so that each test area does not exceed 1000 sq. ft., and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.

    a. Anhydrous Calcium Chloride Test: ASTM F1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. in 24 hours.
    b. Relative Humidity Test: Using in-situ probes, ASTM F2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement.

C. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended in writing by manufacturer. Do not use solvents.

D. Use trowelable leveling and patching compound to fill cracks, holes, and depressions in substrates.

E. Move flooring and installation materials into spaces where they will be installed at least 48 hours in advance of installation unless manufacturer recommends a longer period in writing.

1. Do not install flooring until it is the same temperature as space where it is to be installed.

F. Sweep and vacuum clean substrates to be covered by flooring immediately before installation. After cleaning, examine substrates for moisture, alkaline salts, carbonation, and dust. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 FLOORING INSTALLATION, GENERAL

A. Comply with manufacturer's written installation instructions.

B. Scribe, cut, and fit flooring to butt neatly and tightly to vertical surfaces, equipment anchors, floor outlets, and other interruptions of floor surface.

C. Extend flooring into toe spaces, door reveals, closets, and similar openings unless otherwise indicated.

D. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating subfloor markings on flooring. Use nonpermanent, nonstaining marking device.

3.4 FLOOR TILE INSTALLATION

A. Lay out tiles from center marks established with principal walls, discounting minor offsets, so tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half tile at perimeter.

1. Lay tiles square with room axis in pattern indicated.

B. Discard broken, cracked, chipped, or deformed tiles.

C. Adhered Floor Tile: Adhere products to substrates using a full spread of adhesive applied to substrate to comply with adhesive and flooring manufacturers' written instructions, including those for trowel notching, adhesive mixing, and adhesive open and working times.

1. Provide completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

3.5 CLEANING AND PROTECTION

A. Perform the following operations immediately after completing flooring installation:

1. Remove adhesive and other blemishes from flooring surfaces.
2. Sweep and vacuum flooring thoroughly.
3. Damp-mop flooring to remove marks and soil after time period recommended in writing by manufacturer.

B. Protect flooring from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period. Use protection methods recommended in writing by manufacturer.

1. Do not move heavy and sharp objects directly over flooring. Protect flooring with plywood or hardboard panels to prevent damage from storing or moving objects over flooring.

END OF SECTION

This page is intentionally left blank.

SECTION 09 66 23 - RESINOUS MATRIX TERRAZZO FLOORING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Thin-set, epoxy-resin terrazzo flooring.
2. Precast epoxy-resin terrazzo units.

B. Related Requirements:

1. Section 079200 "Joint Sealants" for sealants installed with terrazzo.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review methods and procedures related to terrazzo including, but not limited to, the following:

a. Inspect and discuss condition of substrate and other preparatory work performed by other trades.
b. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
c. Review special terrazzo designs and patterns.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:

1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.
2. Product Data: For adhesives, indicating VOC content.
3. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting materials.
4. Laboratory Test Reports: For sealers, indicating compliance with requirements for low-emitting materials.

C. Shop Drawings: Include terrazzo installation requirements. Include plans, sections, component details, and relationship to other work. Show layout of the following:

1. Divider strips.

2. Control-joint strips.
3. Accessory strips.
4. Abrasive strips.
5. Stair treads, risers, and landings.
6. Precast terrazzo jointing and edge configurations.
7. Terrazzo patterns.

D. Samples for Verification: For each type, material, color, and pattern of terrazzo and accessory required showing the full range of color, texture, and pattern variations expected. Label each terrazzo Sample to identify manufacturer's matrix color and aggregate types, sizes, and proportions. Prepare Samples of same thickness and from same material to be used for the Work, in sizes indicated below:

1. Terrazzo: 12-inch- square Samples.
2. Precast Terrazzo Base: 12-inch-long Samples.
3. Precast Terrazzo Tread and Riser: Full height and depth of tread by 12-inch long sample with abrasive nosing.
4. Accessories: 6-inch- long Samples of each exposed strip item required.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Material Certificates: For each type of terrazzo material or product.

C. Installer Certificates: Signed by manufacturers certifying that installers comply with requirements.

D. Preinstallation moisture-testing reports.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For terrazzo to include in maintenance manuals.

1.6 QUALITY ASSURANCE

A. Installer Qualifications:

1. Engage an installer who is a contractor member of NTMA.
2. Engage an installer who is certified in writing by terrazzo manufacturer as qualified to install manufacturer's products.

B. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.

1. Build mockups for terrazzo including accessories.

a. Atrium Floor Medallion: Standalone mockup of one-quarter of the medallion design as indicted on Drawings.

b. In-Place Mockup:

1) Size: Minimum 100 sq. ft. of typical poured-in-place flooring and base condition for each color and pattern in locations approved by Architect.
2) Include first three stair treads.

2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to Project site in supplier's original wrappings and containers, labeled with source's or manufacturer's name, material or product brand name, and lot number if any.

B. Store materials in their original, undamaged packages and containers, inside a well-ventilated area protected from weather, moisture, soiling, extreme temperatures, and humidity.

1.8 FIELD CONDITIONS

A. Environmental Limitations: Comply with manufacturer's written instructions for substrate temperature, ambient temperature, moisture, ventilation, and other conditions affecting terrazzo installation.

B. Field Measurements: Verify actual dimensions of construction contiguous with precast terrazzo by field measurements before fabrication.

C. Provide permanent lighting or, if permanent lighting is not in place, simulate permanent lighting conditions during terrazzo installation.

D. Close spaces to traffic during terrazzo application and for not less than 24 hours after application unless manufacturer recommends a longer period.

E. Control and collect water and dust produced by grinding operations. Protect adjacent construction from detrimental effects of grinding operations.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain primary terrazzo materials from single source from single manufacturer. Provide secondary materials including patching and fill material, joint sealant, and repair materials of type and from source recommended by manufacturer of primary materials.

B. Source Limitations for Aggregates: Obtain each color, grade, type, and variety of granular materials from single source with resources to provide materials of consistent quality in appearance and physical properties.

2.2 PERFORMANCE REQUIREMENTS

A. NTMA Standards: Comply with NTMA's written recommendations for terrazzo type indicated unless more stringent requirements are specified.

B. Verify flooring products comply with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

2.3 EPOXY-RESIN TERRAZZO

A. Epoxy-Resin Terrazzo: Comply with manufacturer's written instructions for matrix and aggregate proportions and mixing.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Crossfield Products Corp; Dex-O-Tex Cheminert.
b. Key Resin Company; Key Epoxy Terrazzo.
c. Master Terrazzo Technologies LLC; Morricite.
d. Sherwin-Williams High Performance Flooring; Terrazzo 1100.
e. Terrazzo & Marble Supply Companies; Terroxy Resin Systems.

B. Mix Color and Pattern: As preselected and indicated in the Finish Schedule on the Drawings. Match Architect's sample.

C. Materials:

1. Moisture-Vapor-Emission-Control Membrane: Two-component, high-solids, high-density, low-odor, epoxy-based membrane-forming product produced by epoxy terrazzo manufacturer that reduces moisture emission from concrete substrate to not more than 3 lb of water/1000 sq. ft. in 24 hours.
2. Substrate-Crack-Suppression Membrane: Product of terrazzo-resin manufacturer, having minimum 120 percent elongation potential according to ASTM D412.

a. Reinforcement: Fiberglass scrim.

3. Primer: Manufacturer's product recommended for substrate and use indicated.
4. Epoxy-Resin Matrix: Manufacturer's standard recommended for use indicated and in color required for mix indicated.

a. Physical Properties without Aggregates:

1) Hardness: 60 to 85 per ASTM D2240, Shore D.
2) Minimum Tensile Strength: 3000 psi per ASTM D638 for a 2-inch specimen made using a "C" die per ASTM D412.
3) Minimum Compressive Strength: 10,000 psi per ASTM D695, Specimen B cylinder.
4) Chemical Resistance: No deleterious effects by contaminants listed below after seven-day immersion at room temperature per ASTM D1308.

a) Distilled water.
b) Mineral water.

c) Isopropanol.
d) Ethanol.
e) 0.025 percent detergent solution.
f) 1.0 percent soap solution.
g) 5 percent acetic acid.
h) 10 percent sodium hydroxide.
i) 10 percent hydrochloric acid.
j) 30 percent sulfuric acid.

b. Physical Properties with Aggregates: For terrazzo blended according to manufacturer's recommendations with one part epoxy resin with three parts marble aggregate consisting of 60 percent No. 1 chips and 40 percent No. 0 chips that is ground and grouted to a 1/4-inch nominal thickness, and cured for 7 days at 75 deg F plus or minus 2 deg F and at 50 percent plus or minus 2 percent relative humidity.

1) Flammability: Self-extinguishing, maximum extent of burning 1/4 inch according to ASTM D635.
2) Thermal Coefficient of Linear Expansion: 0.0025 inch/inch per deg F according to ASTM C531.

5. Aggregates: Comply with NTMA gradation standards for mix indicated and contain no deleterious or foreign matter.

a. Abrasion and Impact Resistance: Less than 40 percent loss per ASTM C131/C131M.
b. 24-Hour Absorption Rate: Less than 0.75 percent.
c. Dust Content: Less than 1.0 percent by weight.

6. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content to the greatest extent possible and consistent with Project checklist attached to Section 01 81 13.14.
7. Finishing Grout: Resin based.

2.4 PRECAST EPOXY-RESIN TERRAZZO

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Concord Terrazzo Company, Inc.; Terrazzco Brand.
2. Precast Terrazzo Enterprises, Inc.
3. Romoco Precast Terrazzo Products; a subsidiary of Roman Mosaic & Tile Company.
4. Wausau Tile, Inc.

B. Precast Terrazzo Base: Minimum 3/8-inch-thick, epoxy terrazzo units cast in maximum lengths possible, but not less than 36 inches. Comply with manufacturer's written instructions for fabricating precast terrazzo base units in sizes and profiles indicated.

1. Type: As indicated.
2. Top Edge: Straight, with polished top surface.
3. Metal Toe Strip: Brass.
4. Outside Corner Units: With finished returned edges at outside corner.

5. Color, Pattern, and Finish: As preselected and indicated in the Finish Schedule on the Drawings.

C. Precast Terrazzo Stair Treads and Landings: Epoxy terrazzo units cast in maximum lengths possible. Comply with manufacturer's written instructions for fabricating precast terrazzo units in sizes and profiles indicated.

1. Epoxy Resin Matrix: Manufacturer's standard, recommended for use indicated.
2. Aggregates: Comply with NTMA gradation standards for mix indicated, and containing no deleterious or foreign matter.

    a. Abrasion and Impact Resistance: Less than 40 percent loss per ASTM C131/C131M.
    b. 24-Hour Absorption Rate: Less than 0.75 percent.
    c. Dust Content: Less than 1.0 percent by weight.

3. Reinforcement: ASTM A615/A615M, Grade 60 bars, as required by unit size, profile, and thickness.
4. Abrasive Inserts: 1/2-inch-wide, aluminum oxide/epoxy mixture.

    a. Provide three inserts, 1/2 inch apart, with first insert located 1 inch from nosing at adjacent stair riser locations.

5. Color: As preselected and indicated in the Finish Schedule on the Drawings.
6. Finish: Honed.
7. Surface Sealer: Slip and stain-resistant, penetrating sealer that is chemically neutral with pH factor between 7 and 12; does not affect color or physical properties of terrazzo type indicated; is recommend by sealer manufacturer for use with specified terrazzo; and complies with NTMA guide specification for terrazzo type applicable for this Project.

2.5 STRIP MATERIALS

A. Thin-Set Divider Strips: L-type angle in depth required for topping thickness indicated.

1. Material: Brass.
2. Top Width: 1/8 inch.

B. Heavy-Top Divider Strips: L-type angle in depth required for topping thickness indicated.

1. Bottom-Section Material: Matching top-section material.
2. Top-Section Material: Brass.
3. Top-Section Width: 1/4 inch.

C. Control-Joint Strips: Separate, double L-type angles, positioned back to back, that match material and color of divider strips and in depth required for topping thickness indicated.

D. Accessory Strips: Match divider-strip width, material, and color unless otherwise indicated. Use the following types of accessory strips as required to provide a complete installation:

1. Base-bead strips for exposed top edge of terrazzo base.
2. Edge-bead strips for exposed edges of terrazzo.
3. Nosings for terrazzo stair treads and landings.

E. Abrasive Strips: Three-line abrasive inserts at nosings. Silicon carbide or aluminum oxide, or combination of both, in epoxy-resin binder and set in channel.

1. Width: 1/2 inch unless indicated otherwise.
2. Depth: As required by terrazzo thickness.
3. Length: 4 inches less than stair width.
4. Color: As selected by Architect from full range of industry colors.

2.6 MISCELLANEOUS ACCESSORIES

A. Strip Adhesive: Epoxy-resin adhesive recommended by adhesive manufacturer for this use.

1. Verify adhesives have a VOC content of 70 g/L or less.
2. Verify adhesive complies with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

B. Anchoring Devices:

1. Strips: Provide mechanical anchoring devices or adhesives for strip materials as recommended by manufacturer and as required for secure attachment to substrate.
2. Precast Terrazzo: Provide mechanical anchoring devices as recommended by fabricator for proper anchorage and support of units for conditions of installation and support.

C. Patching and Fill Material: Terrazzo manufacturer's resinous product approved and recommended by manufacturer for application indicated.

D. Joint Compound: Terrazzo manufacturer's resinous product approved and recommended by manufacturer for application indicated.

E. Resinous Matrix Terrazzo Cleaner: Chemically neutral cleaner with pH factor between 7 and 10 that is biodegradable, phosphate free, and recommended by sealer manufacturer for use on terrazzo type indicated.

F. Sealer: Slip- and stain-resistant, penetrating-type sealer that is chemically neutral; does not affect terrazzo color or physical properties; and is recommended by sealer manufacturer.

1. Surface Friction: Not less than 0.6 according to ASTM D2047.
2. Acid-Base Properties: With pH factor between 7 and 10.
3. Verify products comply with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions, including levelness tolerances, have been corrected.

3.2 PREPARATION

A. Clean substrates of substances, including oil, grease, and curing compounds, that might impair terrazzo bond. Provide clean, dry, and neutral substrate for terrazzo application.

B. Concrete Slabs:

1. Provide sound concrete surfaces free of laitance, glaze, efflorescence, curing compounds, form-release agents, dust, dirt, grease, oil, and other contaminants incompatible with terrazzo.

    a. Shot-blast surfaces with an apparatus that abrades the concrete surface, contains the dispensed shot within the apparatus, and recirculates the shot by vacuum pickup.
    b. Repair damaged and deteriorated concrete according to terrazzo manufacturer's written instructions.
    c. Use patching and fill material to fill holes and depressions in substrates according to terrazzo manufacturer's written instructions.

C. Verify that concrete substrates are dry and moisture-vapor emissions are within acceptable levels according to manufacturer's written instructions.

D. Preinstallation Moisture Testing:

1. Testing Agency: Engage a qualified testing agency to perform tests.
2. Moisture Testing: Perform tests so that each test area does not exceed 1000 sq. ft., and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.

    a. Moisture-Vapor-Emission Test: Maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. in 24 hours when tested according to ASTM F1869 using anhydrous calcium chloride.
    b. Relative Humidity Test: Maximum 75 percent relative humidity measurement when tested according to ASTM F2170 using in-situ probes.

3. Proceed with terrazzo installation only after concrete substrates pass moisture testing or after installation of moisture-vapor-emission-control membrane on substrate areas that fail testing.

E. Moisture-Vapor-Emission-Control Membrane: Install according to manufacturer's written instructions.

1. Install concrete substrates that fail preinstallation moisture testing.

F. Substrate-Crack-Suppression Membrane: Install to isolate and suppress substrate cracks according to manufacturer's written instructions.

1. Prepare and prefill substrate cracks with membrane material.
2. Install membrane to produce full substrate coverage in areas to receive terrazzo.

G. Protect other work from water and dust generated by grinding operations. Control water and dust to comply with environmental protection regulations.

1. Erect and maintain temporary enclosures and other suitable methods to limit water damage and dust migration and to ensure adequate ambient temperatures and ventilation conditions during installation.

3.3 EPOXY-RESIN TERRAZZO INSTALLATION

A. Comply with NTMA's written recommendations for terrazzo and accessory installation.

B. Strip Materials:

1. Divider and Control-Joint Strips:

a. Locate divider strips in locations indicated.
b. Install control-joint strips with 1/4-inch gap between strips, and install sealant in gap.
c. Install strips in adhesive setting bed without voids below strips, or mechanically anchor strips as required to attach strips to substrate, as recommended by strip manufacturer.

2. Accessory Strips: Install as required to provide a complete installation.
3. Abrasive Strips: Install with surface of abrasive strip positioned 1/16 inch higher than terrazzo surface.

C. Apply primer to terrazzo substrates according to manufacturer's written instructions.

D. Place, rough grind, grout, cure grout, fine grind, and finish terrazzo according to manufacturer's written instructions.

1. Installed Thickness: 3/8 inch nominal.
2. Terrazzo Finishing: Ensure that matrix components and fluids from grinding operations do not stain terrazzo by reacting with divider and control-joint strips.

a. Rough Grinding: Grind with 24-grit or finer stones or with comparable diamond abrasives. Follow initial grind with 60/80-grit stones or with comparable diamond abrasives.
b. Grouting: Before grouting, clean terrazzo with water, rinse, and allow to dry. Apply and cure epoxy grout.
c. Fine Grinding/Polishing: Delay fine grinding until heavy trade work is complete and construction traffic through area is restricted. Grind with 120-grit stones or with comparable diamond abrasives until grout is removed from surface.

3. Installation Tolerance: Limit variation in terrazzo surface from level to 1/4 inch in 10 feet; noncumulative.

3.4 PRECAST TERRAZZO INSTALLATION

A. Install precast terrazzo units using method recommended in writing by NTMA and manufacturer unless otherwise indicated.

B. Do not install units that are chipped, cracked, discolored, or improperly finished.

C. Seal joints between units with joint compound matching precast terrazzo matrix.

3.5 REPAIR

A. Cut out and replace terrazzo areas that evidence lack of bond with substrate. Cut out terrazzo areas in panels defined by strips and replace to match adjacent terrazzo, or repair panels according to NTMA's written recommendations, as approved by Architect.

3.6 CLEANING AND PROTECTION

A. Cleaning:

1. Remove grinding dust from installation and adjacent areas.
2. Wash surfaces with cleaner according to NTMA's written recommendations and manufacturer's written instructions; rinse surfaces with water and allow them to dry thoroughly.

B. Sealing:

1. Seal surfaces according to NTMA's written recommendations.
2. Apply sealer according to sealer manufacturer's written instructions.

C. Protection: Provide final protection and maintain conditions, in a manner acceptable to Installer, that ensure that terrazzo is without damage or deterioration at time of Substantial Completion.

END OF SECTION

SECTION 09 68 13 - TILE CARPETING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Modular carpet tile.

B. Related Requirements:

1. Section 096513 "Resilient Base and Accessories" for resilient wall base and accessories installed with carpet tile.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include manufacturer's written data on physical characteristics, durability, and fade resistance.
2. Include manufacturer's written installation recommendations for each type of substrate.

B. Sustainable Design Submittals:

1. Product Data: For adhesives, indicating VOC content.
2. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting materials.
3. Laboratory Test Reports: For flooring products, indicating compliance with requirements for low-emitting materials.

C. Shop Drawings: For carpet tile installation, plans showing the following:

1. Columns, doorways, enclosing walls or partitions, built-in cabinets, and locations where cutouts are required in carpet tiles.
2. Carpet tile type, color, and dye lot.
3. Type of subfloor.
4. Type of installation.
5. Pattern of installation.
6. Pattern type, location, and direction.
7. Pile direction.
8. Type, color, and location of insets and borders.
9. Type, color, and location of edge, transition, and other accessory strips.
10. Transition details to other flooring materials.

D. Samples for Verification: For each of the following products and for each color and texture required. Label each Sample with manufacturer's name, material description, color, pattern, and designation indicated on Drawings and in schedules.

1. Carpet Tile: Full-size Sample.
2. Exposed Edge, Transition, and Other Accessory Stripping: 12-inch-long Samples.

E. Sustainable Product Certification: Provide ANSI/NSF 140 certification for carpet products.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Test Reports: For carpet tile, for tests performed by a qualified testing agency.

C. Sample Warranty: For special warranty.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For carpet tiles to include in maintenance manuals. Include the following:

1. Methods for maintaining carpet tile, including cleaning and stain-removal products and procedures and manufacturer's recommended maintenance schedule.
2. Precautions for cleaning materials and methods that could be detrimental to carpet tile.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Carpet Tile: Full-size units equal to 5 percent of amount installed for each type indicated, but not less than 10 sq. yd..

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who is certified by the International Certified Floorcovering Installers Association at the Commercial II certification level.

B. Product Options: Information on Drawings and in Specifications establishes requirements for aesthetic effects and performance characteristics of assemblies. Aesthetic effects are indicated by color, pattern, face weight, backing, and pattern repeat.

1. Do not change intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If changes are proposed, submit comprehensive explanatory data to Architect for review.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Comply with the Carpet and Rug Institute's CRI 104.

1.8 FIELD CONDITIONS

A. Comply with the Carpet and Rug Institute's CRI 104 for temperature, humidity, and ventilation limitations.

B. Environmental Limitations: Do not deliver or install carpet tiles until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at levels planned for building occupants during the remainder of the construction period.

C. Do not install carpet tiles over concrete slabs until slabs have cured and are sufficiently dry to bond with adhesive and concrete slabs have pH range recommended by carpet tile manufacturer.

D. Where demountable partitions or other items are indicated for installation on top of carpet tiles, install carpet tiles before installing these items.

1.9 WARRANTY

A. Special Warranty for Carpet Tiles: Manufacturer agrees to repair or replace components of carpet tile installation that fail in materials or workmanship within specified warranty period.

1. Warranty does not include deterioration or failure of carpet tile due to unusual traffic, failure of substrate, vandalism, or abuse.
2. Failures include, but are not limited to, the following:

a. More than 10 percent edge raveling, snags, and runs.
b. Dimensional instability.
c. Excess static discharge.
d. Loss of tuft-bind strength.
e. Loss of face fiber.
f. Delamination.

3. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 CARPET TILE

A. Basis-of-Design Products: Subject to compliance with requirements, provide products as preselected and indicated in the Finish Schedule on the Drawings or comparable product by one of the following:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Bentley Prince Street, Inc.
b. Interface, LLC.
c. Mannington Mills, Inc.

d. Milliken & Company.
e. Shaw Contract Group; a Berkshire Hathaway company.
f. Tandus; a Tarkett company.

B. Construction, Size, Weight, Backing, Color and Pattern: According to basis-of-design selections preselected and indicated in the Finish Schedule on the Drawings.

1. Provide custom design where indicated.

C. Applied Treatments:

1. Soil-Resistance Treatment: Manufacturer's standard treatment.
2. Antimicrobial Treatment: Manufacturer's standard treatment that protects carpet tiles as follows:

a. Antimicrobial Activity: Not less than 2-mm halo of inhibition for gram-positive bacteria, not less than 1-mm halo of inhibition for gram-negative bacteria, and no fungal growth, according to AATCC 174.

D. Sustainable Design Requirements:

1. Sustainable Product Certification: Silver level certification according to ANSI/NSF 140.
2. Verify flooring products comply with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

E. Performance Characteristics:

1. Critical Radiant Flux Classification: Not less than 0.22 W/sq. cm according to NFPA 253.

2.2 INSTALLATION ACCESSORIES

A. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided or recommended by carpet tile manufacturer.

B. Adhesives: Water-resistant, mildew-resistant, nonstaining, pressure-sensitive type to suit products and subfloor conditions indicated, that comply with flammability requirements for installed carpet tile, and are recommended by carpet tile manufacturer for releasable installation.

1. Verify adhesives have a VOC content of 50 g/L or less.
2. Verify adhesive complies with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

C. Metal Edge/Transition Strips: Extruded aluminum with mill finish of profile and width shown, of height required to protect exposed edge of carpet, and of maximum lengths to minimize running joints.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for maximum moisture content, alkalinity range, installation tolerances, and other conditions affecting carpet tile performance.

B. Examine carpet tile for type, color, pattern, and potential defects.

C. Concrete Slabs: Verify that finishes comply with requirements specified in Section 033000 "Cast-in-Place Concrete" and that surfaces are free of cracks, ridges, depressions, scale, and foreign deposits.

1. Moisture Testing: Perform tests so that each test area does not exceed 1000 sq. ft., and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.

    a. Anhydrous Calcium Chloride Test: ASTM F1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. in 24 hours.
    b. Relative Humidity Test: Using in situ probes, ASTM F2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement.
    c. Perform additional moisture tests recommended in writing by adhesive and carpet tile manufacturers. Proceed with installation only after substrates pass testing.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. General: Comply with the Carpet and Rug Institute's CRI 104 and with carpet tile manufacturer's written installation instructions for preparing substrates indicated to receive carpet tile.

B. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, depressions, and protrusions in substrates. Fill or level cracks, holes and depressions 1/8 inch wide or wider, and protrusions more than 1/32 inch unless more stringent requirements are required by manufacturer's written instructions.

C. Concrete Substrates: Remove coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, without using solvents. Use mechanical methods recommended in writing by adhesive and carpet tile manufacturers.

D. Broom and vacuum clean substrates to be covered immediately before installing carpet tile.

3.3 INSTALLATION

A. General: Comply with the Carpet and Rug Institute's CRI 104, Section 10, "Carpet Tile," and with carpet tile manufacturer's written installation instructions.

B. Installation Method: Glue down; install every tile with full-spread, releasable, pressure-sensitive adhesive.

C. Maintain dye-lot integrity. Do not mix dye lots in same area.

D. Maintain pile-direction patterns recommended in writing by carpet tile manufacturer.

E. Cut and fit carpet tile to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Bind or seal cut edges as recommended by carpet tile manufacturer.

F. Extend carpet tile into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.

G. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on carpet tile as marked on subfloor. Use nonpermanent, nonstaining marking device.

H. Install pattern parallel to walls and borders.

3.4 CLEANING AND PROTECTION

A. Perform the following operations immediately after installing carpet tile:

1. Remove excess adhesive and other surface blemishes using cleaner recommended by carpet tile manufacturer.
2. Remove yarns that protrude from carpet tile surface.
3. Vacuum carpet tile using commercial machine with face-beater element.

B. Protect installed carpet tile to comply with the Carpet and Rug Institute's CRI 104, Section 13.7.

C. Protect carpet tile against damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by carpet tile manufacturer.

END OF SECTION

SECTION 09 75 13 - STONE WALL FACING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Dimension stone paneling on interior walls and columns, including stone trim, stone base, and stone window stools.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each variety of stone, stone accessory, and manufactured product.

B. Sustainable Design Submittals:

1. Laboratory Test Reports: For sealers, indicating compliance with requirements for low-emitting materials.

C. Shop Drawings: Show fabrication and installation details for stone paneling system, including dimensions and profiles of stone units.

1. Show locations and details of joints both within stone paneling system and between stone paneling system and other finish materials.
2. Show locations and details of anchors, including locations of supporting construction.
3. Show direction of veining, grain, or other directional pattern.

D. Samples for Verification:

1. For each stone type indicated, in sets of Samples not less than 12 inches square. Include five or more Samples in each set and show the full range of variations in appearance characteristics in completed Work.
2. For each color of sealant required.

E. Delegated-Design Submittal: For stone paneling assembly.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer, fabricator, professional engineer.

B. Material Test Reports:

1. Stone Test Reports: For each stone variety proposed for use on Project, by a qualified testing agency, indicating compliance with required physical properties, other than abrasion resistance, according to referenced ASTM standards. Base reports on testing done within previous five years.
2. Sealant Compatibility and Adhesion Test Report: From sealant manufacturer indicating that sealants will not stain or damage stone. Include interpretation of test results and recommendations for primers and substrate preparation needed for adhesion.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For stone paneling to include in maintenance manuals. Include product data for stone-care products used or recommended by Installer and names, addresses, and telephone numbers of local sources for products.

1.6 QUALITY ASSURANCE

A. Fabricator Qualifications: Shop that employs skilled workers who custom fabricate stone paneling similar to that required for this Project, and whose products have a record of successful in-service performance.

B. Installer Qualifications: A firm or individual experienced in installing stone paneling similar in material, design, and extent to that indicated for this Project, whose work has a record of successful in-service performance.

C. Mockups: Build mockups to demonstrate aesthetic effects and to set quality standards for fabrication and installation.

1. Build mockups for the following kinds of stone paneling:

    a. Typical stone wall paneling, not less than 72 inches long by full height.
    b. Typical stone wainscot paneling, not less than 72 inches long by full wainscot height.
    c. Typical column facing, one complete column.
    d. Sealant pointing of joints.

2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 PRECONSTRUCTION TESTING

A. Preconstruction Sealant Adhesion and Compatibility Testing: Submit to joint-sealant manufacturers, for compatibility and adhesion testing according to sealant manufacturer's standard testing methods and Section 079200 "Joint Sealants," Samples of materials that will contact or affect joint sealants.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Store and handle stone and related materials to prevent deterioration or damage due to moisture, temperature changes, contaminants, corrosion, breaking, chipping, and other causes.

1. Lift stone with wide-belt slings; do not use wire rope or ropes that might cause staining. Move stone, if required, using dollies with cushioned wood supports.
2. Store stone on wood A-frames or pallets with nonstaining, waterproof covers. Arrange to distribute weight evenly and to prevent damage to stone. Ventilate under covers to prevent condensation.

B. Mark stone units, on surface that will be concealed after installation, with designations used on Shop Drawings to identify individual stone units. Orient markings on vertical panels so that they are right side up when units are installed.

C. Deliver sealants to Project site in original unopened containers labeled with manufacturer's name, product name and designation, color, expiration period, pot life, curing time, and mixing instructions for multicomponent materials.

D. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.

1.9 FIELD CONDITIONS

A. Maintain air and material temperatures to comply with requirements of installation material manufacturers, but not less than 50 deg F during installation and for seven days after completion.

B. Field Measurements: Verify dimensions of construction to receive stone paneling by field measurements before fabrication and indicate measurements on Shop Drawings.

1.10 COORDINATION

A. Coordinate installation of inserts that are to be embedded in concrete or masonry and similar items to be used by stone paneling Installer for anchoring and supporting stone paneling. Furnish setting drawings, templates, and directions for installing such items and deliver to Project site in time for installation.

B. Time delivery and installation of stone paneling to avoid extended on-site storage and to coordinate with work adjacent to stone paneling.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations for Stone: Obtain each variety of stone, regardless of finish, from a single quarry, whether specified in this Section or in another Section of the Specifications, with resources to provide materials of consistent quality in appearance and physical properties.

1. For stone types that include same list of varieties and sources, provide same variety from same source for each.
2. Make stone slabs available for examination by Architect.

    a. Architect will select aesthetically acceptable slabs and will indicate aesthetically unacceptable portions of slabs.
    b. Segregate slabs selected for use on Project and mark backs indicating approval.
    c. Mark and photograph aesthetically unacceptable portions of slabs as directed by Architect.

2.2 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design stone paneling system.

B. General: Design stone anchors and anchoring systems according to ASTM C1242.

2.3 MARBLE

A. Material Standard: Comply with ASTM C503/C503M, Classification I Calcite.

B. Description: Uniform, fine- to medium-grained, white stone with veining.

C. Varieties and Sources: Subject to compliance with requirements, available stone varieties that may be incorporated into the Work include, but are not limited to, the following:

1. As preselected and indicated in Finish Schedule.

D. Cut: Cross cut.

1. Orientation of Veining: As indicated.

E. Cut stone from one block or contiguous, matched blocks in which natural markings occur.

F. Finish: Polished.

G. Match Architect's samples for color, finish, and other stone characteristics relating to aesthetic effects.

2.4 SETTING MATERIALS

A. Molding Plaster: ASTM C59/C59M.

B. Portland Cement: ASTM C150/C150M, Type I or Type II.

1. Low-Alkali Cement: Not more than 0.60 percent total alkali when tested according to ASTM C114.

C. Hydrated Lime: ASTM C207, Type S.

D. Aggregate: ASTM C144.

E. Water: Potable.

2.5 SEALANTS

A. Joint Sealants: Manufacturer's standard sealants that comply with applicable requirements in Section 07 92 00 "Joint Sealants" and will not stain the stone they are applied to.

1. Colors: Custom color to harmonize with stone wall facing.

B. Sealant for Filling Kerfs: Manufacturer's standard chemically curing, elastomeric sealants of base polymer and characteristics indicated below that comply with applicable requirements in Section 07 92 00 "Joint Sealants" and that do not stain stone:

1. Silicone, Nonstaining, S, NS, 50, NT: Nonstaining, single-component, nonsag, plus 50 percent and minus 50 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 50, Use NT.

a. Basis-of-Design Product: Subject to compliance with requirements, provide **The Dow Chemical Company; 756 SMS** or a comparable product by one of the following:

1) GE Construction Sealants; Momentive Performance Materials Inc.
2) Tremco Incorporated.

2.6 STONE ANCHORS AND ATTACHMENTS

A. Fabricate anchors from stainless steel, ASTM A240/A240M or ASTM A666, Type 304.

1. Fasteners for Stainless-Steel Anchors: Annealed stainless-steel bolts, nuts, and washers; ASTM F593 for bolts and ASTM F594 for nuts, Alloy Group 1.

B. Fabricate dowels from stainless steel, ASTM A276, Type 304.

C. Wire Tiebacks: No. 9 AWG copper or copper-alloy or 0.120-inch-diameter, stainless-steel wire.

2.7 STONE ACCESSORIES

A. Temporary Setting Shims: Rigid plastic shims, nonstaining to stone, sized to suit joint thickness.

B. Setting Shims for Direct-Mount Anchoring Systems: Strips of resilient plastic or neoprene, nonstaining to stone, of thickness needed to prevent point loading of stone on anchors and of depths to suit anchors without intruding into required depths of pointing materials.

C. Cleaner: Stone cleaner specifically formulated for stone types, finishes, and applications indicated, as recommended by stone producer. Do not use cleaning compounds containing acids, caustics, harsh fillers, or abrasives.

2.8 FABRICATION OF STONE, GENERAL

A. Select stone for intended use to prevent fabricated units from containing cracks, seams, and starts that could impair structural integrity or function.

1. Repairs that are characteristic of the varieties specified are acceptable provided they do not impair structural integrity or function and are not aesthetically unpleasing, as judged by Architect.

B. Fabricate stone paneling in sizes and shapes required to comply with requirements indicated.

1. For marble, comply with recommendations in MIA's "Dimension Stone - Design Manual VII."

C. Cut stone to produce pieces of thickness, size, and shape indicated and to comply with fabrication and construction tolerances recommended by applicable stone association.

1. Where items are installed with adhesive or where stone edges are visible in the finished work, make items uniform in thickness and of identical thickness for each type of item; gage back of stone if necessary.
2. Clean sawed backs of stones to remove rust stains and iron particles.
3. Dress joints straight and at right angle to face unless otherwise indicated.
4. Cut and drill sinkages and holes in stone for anchors, supports, and lifting devices as indicated or needed to set stone securely in place; shape beds to fit supports.
5. Provide openings, reveals, and similar features as needed to accommodate adjacent work.

D. Finish exposed faces and edges of stone to comply with requirements indicated for finish of each stone type required and to match approved Samples and mockups.

E. Carefully inspect finished stone units at fabrication plant for compliance with requirements for appearance, material, and fabrication. Replace defective units.

1. Grade and mark stone for overall uniform appearance when assembled in place. Natural variations in appearance are acceptable if installed stone units match range of colors and other appearance characteristics represented in approved Samples and mockups.

2.9 FABRICATION OF STONE PANELING ON WALLS AND COLUMNS

A. When requested by Architect, arrange panels in shop or other suitable space in proposed orientation and sequence for examination by Architect. Mark units with temporary sequence numbers to indicate position in proposed layout.

1. Lay out one elevation at a time if approved by Architect.
2. Notify Architect seven days in advance of date and time when layout will be available for viewing.
3. Provide lighting of similar type and level as that of final installation for viewing layout unless otherwise approved by Architect.
4. Rearrange panels as directed by Architect until layout is approved.
5. Do not trim nonmodular-size units to less than modular size until after Architect's approval of layout, unless otherwise approved by Architect.

6. Mark backs of units and Shop Drawings with sequence numbers based on approved layout. Mark backs of units to indicate orientation of units in completed Work.

B. Nominal Thickness: 2 cm unless otherwise indicated.

C. Control depth of stone to maintain minimum clearances of 1 inch between backs of panels and structural members, fireproofing if any, backup walls, and other work behind stone. Do not back check stone less than 1 inch thick.

D. Cut stone to produce uniform joints 1/8 inch wide and in locations indicated.

E. Quirk-miter corners unless otherwise indicated. Fabricate for anchorage in top and bottom bed joints of corner units.

F. Pattern Arrangement: Fabricate and arrange panels with veining and other natural markings to comply with the following requirements:

1. Arrange panels with veining as indicated on Drawings.
2. Book match units, single-course height.
3. Book match units, both vertically and horizontally.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine surfaces to receive stone paneling and conditions under which stone paneling will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of stone paneling.

B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of stone paneling.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF STONE, GENERAL

A. Before setting stone, clean surfaces that are dirty or stained by removing soil, stains, and foreign materials. Clean stone by thoroughly scrubbing with fiber brushes and then drenching with clear water. Use only mild cleaning compounds that contain no caustic or harsh materials or abrasives.

B. Do necessary field cutting as stone is set. Use power saws with diamond blades to cut stone. Cut lines straight and true, with edges eased slightly to prevent snipping.

C. Contiguous Work: Provide reveals and openings as required to accommodate contiguous work.

D. Set stone to comply with requirements indicated. Install anchors, supports, fasteners, and other attachments indicated or necessary to secure stone in place. Shim and adjust anchors, supports, and accessories to set stone accurately in locations indicated, with edges and faces aligned according to established relationships and indicated tolerances.

E. Erect stone units level, plumb, and true with uniform joint widths. Use temporary shims to maintain joint width.

3.3 CONSTRUCTION TOLERANCES

A. Variation from Plumb: For vertical lines and surfaces, do not exceed 1/8 inch in 96 inches, 1/4 inch maximum.

B. Variation from Level: For lintels, sills, chair rails, horizontal bands, horizontal grooves, and other conspicuous lines, do not exceed 1/8 inch in 10 feet, 1/4 inch in 20 feet, 1/4 inch maximum.

C. Variation of Linear Building Line: For position shown in plan and related portion of walls and partitions, do not exceed 1/8 inch in 10 feet, 1/4 inch in 20 feet, 1/4 inch maximum.

D. Variation in Cross-Sectional Dimensions: For thickness of walls from dimensions indicated, do not exceed plus or minus 1/8 inch.

E. Variation in Joint Width: Do not vary from average joint width more than plus or minus 1/16 inch or one-fourth of nominal joint width, whichever is less.

F. Variation in Plane between Adjacent Stone Units (Lipping): Do not exceed 1/64-inch difference between planes of adjacent units.

3.4 INSTALLATION OF STONE FACING

A. Set units firmly against setting spots. Locate setting spots at anchors and spaced not more than 18 inches apart across back of unit, but provide no fewer than one setting spot per 2 sq. ft. unless otherwise indicated.

1. Moisture Exposure: Use portland cement mortar for setting spots where stone is applied to inside face of exterior walls and.

B. Set units with anchors securely attached to stone and to backup surfaces. Comply with anchoring recommendations in ASTM C1242.

1. Provide compressible filler in ends of dowel holes and bottoms of kerfs to prevent end bearing of dowels and anchor tabs on stone. Fill remainder of anchor holes and kerfs with sealant for filling kerfs.
2. Set stone supported on clips or continuous angles on resilient setting shims. Use material of thickness required to maintain uniform joint widths and to prevent point loading of stone on anchors. Hold shims back from face of stone a distance at least equal to width of joint.

C. Minimum Anchors: Provide a minimum of four anchors per panel up to 12 sq. ft. in face area, plus a minimum of two additional anchors for each additional 8 sq. ft..

D. Fill joints with sealant after setting stone.

3.5 INSTALLATION OF JOINT SEALANT

A. Prepare joints and apply sealants of type and at locations indicated to comply with applicable requirements in Section 079200 "Joint Sealants." Remove temporary shims before applying sealants.

3.6 ADJUSTING AND CLEANING

A. In-Progress Cleaning: Clean stone paneling as work progresses. Remove adhesive, grout, mortar, and sealant smears immediately.

B. Remove and replace stone paneling of the following description:

1. Broken, chipped, stained, or otherwise damaged stone. Stone may be repaired if methods and results are approved by Architect.
2. Defective stone paneling.
3. Defective joints, including misaligned joints.
4. Stone paneling and joints not matching approved Samples and mockups.
5. Stone paneling not complying with other requirements indicated.

C. Replace in a manner that results in stone paneling that matches approved Samples and mockups, complies with other requirements, and shows no evidence of replacement.

D. Clean stone paneling no fewer than six days after completion of grouting and pointing, using clean water and soft rags or stiff-bristle fiber brushes. Do not use wire brushes, acid-type cleaning agents, cleaning compounds with caustic or harsh fillers, or other materials or methods that could damage stone.

3.7 PROTECTION

A. Protect stone surfaces, edges, and corners from construction damage. Use securely fastened untreated wood, plywood, or heavy cardboard to prevent damage.

B. Before inspection for Substantial Completion, remove protective coverings and clean surfaces.

END OF SECTION

This page is intentionally left blank.

SECTION 09 75 23 - SIMULATED STONE WALL FACING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Quartz agglomerate wall facing.

1.2 ACTION SUBMITTALS

A. Product Data: For simulated stone wall facing materials.

B. Sustainable Design Submittals:

1. Product Data: For adhesives, indicating VOC content.
2. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting materials.

C. Shop Drawings: For wall facing. Show fabrication and installation details for simulated stone paneling system, including dimensions and profiles of simulated stone units.

1. Show locations and details of joints both within simulated stone paneling system and between simulated stone paneling system and other finish materials.
2. Show locations and details of anchors, including locations of supporting construction.
3. Show direction of veining, grain, or other directional pattern as applicable.

D. Samples for Verification: For the following products:

1. Simulated stone facing material material, 12 inches square.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For fabricator.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For simulated stone wall facing to include in maintenance manuals. Include Product Data for care products used or recommended by Installer and names, addresses, and telephone numbers of local sources for products.

1.5 QUALITY ASSURANCE

A. Fabricator Qualifications: Shop that employs skilled workers who custom fabricate simulated stone paneling similar to that required for this Project, and whose products have a record of successful in-service performance.

B. Installer Qualifications: Fabricator of simulated stone wall facing.

C. Mockups: Build mockups to demonstrate aesthetic effects and to set quality standards for fabrication and installation.

1. Build mockups for the following kinds of simulated stone paneling:

a. Typical simulated stone wall paneling, not less than 72 inches long by full height.
b. Typical stone wainscot paneling, not less than 72 inches long by full wainscot height.
c. Sealant pointing of joints.

2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.6 FIELD CONDITIONS

1.7 COORDINATION

PART 2 - PRODUCTS

2.1 QUARTZ AGGLOMERATE WALL FACING MATERIALS

A. Quartz Agglomerate: Solid sheets consisting of quartz aggregates bound together with a matrix of polymers, resins, and pigment and complying with ISFA 3-01.

1. Basis-of-Design Product: Subject to compliance with requirements, provide products by **Cambria** or a comparable product by one of the following:

a. Cosentino North America; C&C North America, Inc.
b. DuPont; DuPont de Nemours, Inc.
c. Wilsonart LLC.

2. Colors and Patterns: As preselected and indicated in Finish Schedule.

2.2 FABRICATION

A. Fabricate wall facing according to quartz agglomerate manufacturer's written instructions.

B. Configuration: As indicated on Drawings.

C. Joints:

1. Fabricate wall facing in sections for joining in field, with joints at locations indicated on Drawings.

a. Joint Type, Bonded: 1/32 inch or less in width.

D. Cutouts:

1. Make cutout for devices in shop to the greatest extent possible.
2. Provide vertical edges, slightly eased at juncture of cutout edges with front and back surfaces of wall facing.

2.3 INSTALLATION MATERIALS

A. Adhesive: Product recommended by quartz agglomerate manufacturer.

1. Verify adhesives have a VOC content of 70 g/L or less.
2. Verify adhesive complies with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates to receive simulated stone material wall facing and conditions under which wall facing will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of wall facing.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Before setting simulated stone wall facing, clean surfaces that are dirty or stained by removing soil, stains, and foreign materials. Clean simulated stone wall facing material thoroughly.

B. Do necessary field cutting as simulated stone wall facing is set. Use power saws with diamond blades to cut simulated stone. Cut lines straight and true, with edges eased slightly to prevent snipping.

C. Contiguous Work: Provide reveals and openings as required to accommodate contiguous work.

D. Set simulated stone wall facing to comply with requirements indicated. Temporarily secure in place until adhesive has cured.

E. Erect stone units level, plumb, and true with uniform joint widths. Use temporary shims to maintain joint width.

END OF SECTION

SECTION 09 84 33 - SOUND-ABSORBING WALL UNITS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes shop-fabricated, acoustical panel units tested for acoustical performance, including the following:

1. Sound-absorbing wall panels.

1.2 DEFINITIONS

A. NRC: Noise Reduction Coefficient.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include fabric facing, core material, and mounting indicated.

B. Sustainable Design Submittals:

1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.
2. Product Data: For adhesives, indicating VOC content.
3. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting materials.
4. Laboratory Test Reports: For wall materials, indicating compliance with requirements for low-emitting materials.

C. Shop Drawings: For unit assembly and installation.

1. Include plans, elevations, sections, and mounting devices and details.
2. Include details at cutouts and penetrations for other work.
3. Include direction of fabric weave and pattern matching.

D. Samples for Verification: For the following products:

1. Fabric: Full-width by approximately 36-inch- long Sample, but not smaller than required to show complete pattern repeat, from dye lot to be used for the Work, and with specified treatments applied. Mark top and face of fabric.
2. Core Material: 12-inch-square Sample at corner.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Elevations and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Electrical outlets, switches, and thermostats.
2. Items penetrating or covered by units including the following:

a. Electrical devices.
b. Video monitor mounts.

B. Product Certificates: For each type of unit.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For each type of unit to include in maintenance manuals. Include fabric manufacturers' written cleaning and stain-removal instructions.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Comply with fabric and unit manufacturers' written instructions for minimum and maximum temperature and humidity requirements for shipment, storage, and handling.

B. Deliver materials and units in unopened bundles and store in a temperature-controlled dry place with adequate air circulation.

1.7 FIELD CONDITIONS

A. Environmental Limitations: Do not install units until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, work at and above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

B. Lighting: Do not install units until a lighting level of not less than 50 fc is provided on surfaces to receive the units.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Verify wall materials comply with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

B. Fire-Test-Response Characteristics: Units shall comply with "Surface-Burning Characteristics" or "Fire Growth Contribution" Subparagraph below, or both, as determined by testing identical

products by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:

1. Surface-Burning Characteristics: Comply with ASTM E84 or UL 723; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

    a. Classification: Class C.

2.2 SOUND-ABSORBING WALL UNITS

A. Sound-Absorbing Wall Panel: Manufacturer's standard panel construction consisting of facing material laminated to front face, long edges, and back edge border of core.

1. Basis-of-Design Product: Subject to compliance with requirements, provide **Homasote Company; DesignWall 440** or a comparable product by one of the following:

    a. Acoustical Panel Systems (APS, Inc.).
    b. Armstrong Ceiling & Wall Solutions.
    c. Conwed.
    d. Decoustics; CertainTeed Architectural Products; a Saint Gobain company.

2. Panel Shape: Flat.
3. Mounting: Back mounted with manufacturer's standard adhesive, secured to substrate.
4. Core: Molded, recycled post-consumer paper, cellulose fiber structural panel.
5. Edge Profile: Square.
6. Corner Detail in Elevation: Square with continuous edge profile indicated.
7. Reveals between Panels: 1/8-inch-wide, flush reveals.
8. Facing Material: As preselected and indicated in Finish Schedule.
9. Acoustical Performance: Sound absorption NRC of 0.20 according to ASTM C423 for Type A mounting according to ASTM E795.
10. Nominal Core Thickness: 1/2 inch.
11. Panel Width: As indicated on Drawings.
12. Panel Height: As indicated on Drawings.

2.3 MATERIALS

A. Recycled Content: Provide products with postconsumer recycled content plus one-half of preconsumer recycled content to the extent required to comply with the minimum criteria specified in Section 01 81 13.14 “Sustainable Design Requirements.”

B. Regional Materials: To the extent required to comply with the minimum criteria specified in Section 01 81 13.14 “Sustainable Design Requirements,” manufacture products within 100 of Project site from materials that have been extracted, harvested, or recovered, as well as manufactured, within 100 miles of Project site.

C. Core Materials:

1. Molded, recycled post-consumer paper, cellulose fiber structural panel:

    a. Density: 26 to 28 lbs./cu. ft.; ASTM C209.
    b. Tensile Strength: According to ASTM C209:

1) Parallel: 450 to 700 lbs./sq. in.
2) Transverse: 450 to 700 lbs./sq. in.

c. Hardness: 230 lbs.; ASTM D1037
d. Water Absorption by Volume: 7 percent maximum; 2 hour immersion according to ASTM C209.
e. Expansion: 0.25 percent; 50 to 90 percent relative humidity according to ASTM C209.

D. Facing Material:

1. Manufacturer: Guilford of Maine.
2. Product Line/Pattern: FR701.
3. Color: As preselected and indicated in Finish Schedule. .
4. Fiber Content: 100 percent woven polyester.

E. Mounting Devices: Concealed on back of unit, recommended by manufacturer to support weight of unit, and as follows:

1. Verify adhesives have a VOC content of 70; g/L or less.
2. Verify adhesive complies with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

2.4 FABRICATION

A. Standard Construction: Use manufacturer's standard construction unless otherwise indicated; with facing material applied to face, edges, and back border of dimensionally stable core.

B. Facing Material: Apply fabric facing fully covering visible surfaces of unit; with material stretched straight, on the grain, tight, square, and free from puckers, ripples, wrinkles, sags, blisters, seams, adhesive, or other visible distortions or foreign matter.

C. Dimensional Tolerances of Finished Units: Plus or minus 1/16 inch for the following:

1. Thickness.
2. Edge straightness.
3. Overall length and width.
4. Squareness from corner to corner.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine fabric, fabricated units, substrates, areas, and conditions for compliance with requirements, installation tolerances, and other conditions affecting unit performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install units in locations indicated. Unless otherwise indicated, install units with vertical surfaces and edges plumb, top edges level and in alignment with other units, faces flush, and scribed to fit adjoining work accurately at borders and at penetrations.

B. Comply with manufacturer's written instructions for installation of units using type of mounting devices indicated. Mount units securely to supporting substrate.

C. Space panel joints 1/8 inch apart.

D. Align fabric pattern and grain with adjacent units.

3.3 INSTALLATION TOLERANCES

A. Variation from Plumb and Level: Plus or minus 1/16 inch in 48 inches, noncumulative.

B. Variation of Joint Width: Not more than 1/16-inch variation from reveal line in 48 inches, noncumulative.

3.4 CLEANING

A. Clip loose threads; remove pills and extraneous materials.

B. Clean panels on completion of installation to remove dust and other foreign materials according to manufacturer's written instructions.

END OF SECTION

This page is intentionally left blank.

SECTION 09 91 23 - INTERIOR PAINTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes surface preparation and the application of paint systems on the following interior substrates:

1. Concrete.
2. Steel and iron.
3. Galvanized metal.
4. Gypsum board.
5. Wood.

B. Related Requirements:

1. Section 09 96 00 "High-Performance Coatings" for high-performance coatings.

1.2 DEFINITIONS

A. Gloss Level 1, Flat: Not more than five units at 60 degrees and 10 units at 85 degrees, according to ASTM D523.

B. Gloss Level 2: Not more than 10 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D523.

C. Gloss Level 3, Eggshell: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D523.

D. Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D523.

E. Gloss Level 5, Semi-gloss: 35 to 70 units at 60 degrees, according to ASTM D523.

F. Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D523.

G. Gloss Level 7, Gloss: More than 85 units at 60 degrees, according to ASTM D523.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product. Include preparation requirements and application instructions. For paints and coatings, including printed statement of VOC content.

B. Sustainable Design Submittals:

1. Product Data: For paints and coatings, indicating VOC content.

2. Laboratory Test Reports: For paints and coatings, indicating compliance with requirements for low-emitting materials.
3. Environmental Product Declaration: For each product.
4. Health Product Declaration: For each product.
5. Sourcing of Raw Materials: Corporate sustainability report for each manufacturer.

C. Samples for Verification: For each type of paint system and in each color and gloss of topcoat.

1. Submit Samples on rigid backing, 8 inches square.
2. Step coats on Samples to show each coat required for system.
3. Label each coat of each Sample.
4. Label each Sample for location and application area.

D. Product List: For each product indicated, include the following:

1. Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules.

1.4 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Paint: 2 percent, but not less than 1 gal. of each material and color applied.

1.5 QUALITY ASSURANCE

A. Mockups: Apply mockups of each paint system indicated and each color and finish selected to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Architect will select one surface to represent surfaces and conditions for application of each paint system specified in Part 3.

a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft.
b. Other Items: Architect will designate items or areas required.

2. Final approval of color selections will be based on mockups.

a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Architect at no added cost to Owner.

3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.

1. Maintain containers in clean condition, free of foreign materials and residue.
2. Remove rags and waste from storage areas daily.

1.7 FIELD CONDITIONS

A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F.

B. Do not apply paints when relative humidity exceeds 85 percent; at temperatures less than above the dew point; or to damp or wet surfaces.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Benjamin Moore & Co.
2. Kelly-Moore Paint Company Inc.
3. PPG Paints.
4. Sherwin-Williams Company (The).

B. Products: Subject to compliance with requirements, provide one of the products listed in the Interior Painting Schedule for the paint category indicated.

2.2 PAINT, GENERAL

A. Material Compatibility:

1. Materials for use within each paint system shall be compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. For each coat in a paint system, products shall be recommended in writing by topcoat manufacturers for use in paint system and on substrate indicated.

B. VOC Content: For field applications that are inside the weatherproofing system, verify paints and coatings comply with VOC content limits of authorities having jurisdiction and the following VOC content limits:

1. Flat Paints and Coatings: 50 g/L.
2. Nonflat Paints and Coatings: 100 g/L.
3. High Gloss Paints and Coatings: 150 g/L.
4. Dry-Fog Coatings: 150 g/L.

5. Primers, Sealers, and Undercoaters: 100 g/L.
6. Rust-Preventive Coatings: 250 g/L.
7. Zinc-Rich Industrial Maintenance Primers: 100 g/L.
8. Pretreatment Wash Primers: 420 g/L.
9. Shellacs, Clear: 730 g/L.
10. Shellacs, Pigmented: 550 g/L.

C. Low-Emitting Materials: For field applications that are inside the weatherproofing system, verify 90 percent of paints and coatings comply with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

D. Colors: As preselected and indicated in the Finish Schedule on the Drawings. The use of a manufacturer’s proprietary color name is not intended to exclude comparable products by other listed manufacturers which are specially formulated to match the named manufacturer’s color.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:

1. Concrete: 12 percent.
2. Masonry (Clay and CMU): 12 percent.
3. Gypsum Board: 12 percent.

C. Gypsum Board Substrates: Verify that finishing compound is dry and sanded smooth.

D. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.

E. Proceed with coating application only after unsatisfactory conditions have been corrected.

1. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Comply with manufacturer's written instructions.

B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.

1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.

C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.

1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.

D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.

E. Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces or mortar joints exceed that permitted in manufacturer's written instructions.

F. Steel Substrates: Remove rust, loose mill scale, and shop primer, if any. Clean using methods recommended in writing by paint manufacturer but not less than the following:

1. SSPC-SP 3, "Power Tool Cleaning."

G. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.

H. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal fabricated from coil stock by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.

3.3 APPLICATION

A. Apply paints according to manufacturer's written instructions.

1. Use applicators and techniques suited for paint and substrate indicated.
2. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
3. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
4. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
5. Primers specified in painting schedules may be omitted on items that are factory primed if approved in writing by topcoat manufacturers.

B. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.

C. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

D. Painting Fire Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:

1. Paint the following work where exposed in equipment rooms and occupied spaces:

    a. Equipment, including panelboards and switch gear.
    b. Uninsulated metal piping.
    c. Uninsulated plastic piping.
    d. Pipe hangers and supports.
    e. Metal conduit.
    f. Plastic conduit.
    g. Tanks that do not have factory-applied final finishes.
    h. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
    i. Mechanical and electrical equipment that is indicated to have a factory-primed finish for field painting.

2. Paint portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets that are visible from occupied spaces.

    a. Color: Black.

3.4 CLEANING AND PROTECTION

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.

D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.5 INTERIOR PAINTING SCHEDULE

A. Concrete Substrates, Traffic Surfaces:

1. Water-Based Concrete Floor Sealer System:

    a. First Coat: Sealer, water based, for concrete floors, matching topcoat.
    b. Topcoat: Sealer, water based, for concrete floors.

        1) PPG; Perma-Crete Plex-Seal WB Interior/Exterior Clear Sealer 4-6200XI.
        2) Sherwin-William; H&C Clarishield Water-Based Wet-Look Concrete Sealer

B. CMU Substrates: At all painted interior CMU.

1. Light Industrial, Water-Based Epoxy over Latex Block Filler

    a. Block Filler: Latex.

1) Benjamin Moore; Ultra Spec, Hi-Build Masonry Block Filler.
2) Kelly-Moore; Premium Professional Prime and Fill Acrylic Block Filler.
3) PPG; Speedhide Interior/Exterior Hi Fill Latex Block Filler 6-15XI.
4) Sherwin-Williams; ProIndustrial Heavy Duty Block Filler.

b. Intermediate Coat: Light industrial epoxy coating, interior, water-based, semi-gloss to match topcoat.
c. Topcoat: Light industrial epoxy coating, interior, water-based, semi-gloss.

1) Benjamin Moore; Pre-Catalyzed Epoxy Semi-Gloss (V341).
2) Kelly-Moore; 1685 Durapoxy Interior Semi-Gloss Enamel.
3) PPG; Pitt-Glaze WB1 Interior Pre-Catalyzed Water-based Acrylic Epoxy 16-510.
4) Sherwin-Williams; Pro Industrial Pre-Catalyzed Epoxy Semi-Gloss.

C. Steel Substrates:

1. Water-Based Light Industrial Coating System: At all painted hollow metal doors and frames, and interior handrails and guardrails.

a. Prime Coat: Primer, rust-inhibitive, water based.

1) Benjamin Moore; Ultra Spec HP, Acrylic Metal Primer HP04.
2) Kelly-Moore; 5725 DTM Acrylic Primer/Finish.
3) PPG; Pitt-Tech Plus DTM Industrial Primer, 90-912.
4) Sherwin-William; Pro Industrial Pro-Cryl Universal Primer, B66-310 Series.

b. Intermediate Coat: Light industrial coating, interior, water based, matching topcoat.
c. Topcoat: Light industrial coating, interior, water based, semi-gloss (MPI Gloss Level 5).

1) Benjamin Moore; Ultra Spec HP, DTM Acrylic Semi-Gloss, HP29.
2) Kelly-Moore; 5885 DTM High Performance Acrylic Semi-Gloss Enamel.
3) PPG; Pitt-Tech Plus Int./Ext. Semi-Gloss DTM Industrial Enamel, 4216 Series.
4) Sherwin-William; Pro Industrial DTM Acrylic Semi-Gloss.

2. Water-Based Dry-Fall System (for overhead work only):

a. Prime Coat: Shop primer specified in Section where substrate is specified.
b. Topcoat: Dry fall, latex (MPI Gloss Level 3).

1) Benjamin Moore & Co.; M53 Sweep-Up Spray Latex Flat.
2) Kelly-Moore; 480 Dry Fog II.
3) PPG; Speedhide Interior Dry-Fog Spray Paint Latex 6-725XI.
4) Sherwin-Williams; Low VOC Waterborne Acrylic Dry Fall B42.

D. Galvanized-Metal Substrates:

1. Water-Based Dry-Fall System (for overhead work only):

a. Prime Coat: Dry fall, water based, for galvanized steel, matching topcoat.
b. Topcoat: Dry fall, latex (MPI Gloss Level 3).

1) Benjamin Moore & Co.; M53 Sweep-Up Spray Latex Flat.
2) Kelly-Moore; 480 Dry Fog II.
3) PPG; Speedhide Interior Dry-Fog Spray Paint Latex 6-725XI.
4) Sherwin-Williams; Low VOC Waterborne Acrylic Dry Fall B42.

E. Gypsum Board and Plaster Substrates:

1. Institutional Low-Odor/VOC Latex System:

a. Prime Coat: Primer sealer, interior, institutional low odor/VOC.

1) Benjamin Moore & Co.; EcoSpec Interior Latex Primer Sealer N372.
2) Kelly-Moore; 971 Acry-Plex, AcryPlex Interior Enamel Undercoater.
3) PPG; Speedhide Zero Interior Latex Primer 6-4900XI.
4) Sherwin-Williams; ProMar 200 Zero VOC Primer.

b. Intermediate Coat: Latex, interior, institutional low odor/VOC, matching topcoat.
c. Topcoat:

1) Indicative Locations:

a) Flat, (MPI Gloss Level 1) at all ceilings.
b) Eggshell sheen, (MPI Gloss Level 3) unless noted otherwise on the Finish Schedule.

2) Topcoat: Latex, interior, institutional low odor/VOC, flat (MPI Gloss Level 1).

a) Benjamin Moore & Co.; EcoSpec Interior Latex Flat N373.
b) Kelly-Moore; 1500 Enviro-coat.
c) PPG; Speedhide Zero Interior Latex Flat 6-4110.
d) Sherwin-William; ProMar 200 Zero VOC Flat, B30-2600 Series.

3) Topcoat: Latex, interior, institutional low odor/VOC, Eggshell (MPI Gloss Level 3).

a) Benjamin Moore & Co.; EcoSpec Interior Latex Eggshell Enamel N374.
b) Kelly-Moore; 1510 Enviro-coat.
c) PPG; Speedhide Zero Interior Latex Eggshell 6-4310.
d) Sherwin-William; ProMar 200 Zero VOC Eg-Shel, B20-2600 Series.

4) Topcoat: Latex, interior, institutional low odor/VOC, semi-gloss (MPI Gloss Level 5).

a) Benjamin Moore & Co.; EcoSpec Interior Latex Semi-Gloss Enamel N376.
b) Kelly-Moore; 1520 Enviro-coat.
c) PPG; Speedhide Zero Interior Latex Semi-Gloss 6-4510.
d) Sherwin-William; ProMar 200 Zero VOC Semi-Gloss, B31-2600 Series.

F. Wood Substrates: For opaque finish.

1. Institutional Low-Odor/VOC Latex System:

    a. Prime Coat: Primer, latex, for interior wood.

        1) Benjamin Moore & Co.; Advance, Waterborne Alkyd Primer N790.
        2) Kelly-Moore; Professional Water-Oil Hybrid Primer/Undercoater, 265 KM.
        3) PPG; Seal Grip, Interior/Exterior Acrylic Universal. Primer/Sealer, 17-921XI,
        4) Sherwin-Williams; Premium Wall and Wood Primer, B28W8111.

    b. Intermediate Coat: Alkyd, water based, matching topcoat.
    c. Topcoat: Alkyd, water based, semi-gloss (MPI Gloss Level 5).

        1) Benjamin Moore & Co.; Advance, Waterborne Alkyd Semi-Gloss N793.
        2) Kelly-Moore; Water-Oil Hydrid Semi-Gloss Enamel.
        3) PPG; Break-Through 250 Interior/Exterior Water-borne Alkyd Semi-Gloss V50-410.
        4) Sherwin-William; ProIndustrial WaterBased Alkyd Urethane, B53 Series.

END OF SECTION

This page is intentionally left blank.

SECTION 09 96 11 - HIGH-PERFORMANCE COATINGS (PROPRIETARY SPECIFICATION)

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes surface preparation and application of high-performance coating systems on the following substrates:

1. Exterior Substrates:

a. Concrete, vertical surfaces.
b. Concrete masonry units (CMU).
c. Steel.
d. Galvanized metal.
e. Portland cement plaster (stucco).

2. Interior Substrates:

a. Concrete, vertical surfaces.
b. Concrete, horizontal surface marking.
c. Concrete masonry units (CMU).
d. Steel.
e. Galvanized metal.
f. Gypsum board.

B. Related Requirements:

1. Section 09 91 23 "Interior Painting" for general field painting.

1.2 DEFINITIONS

A. Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D523.

B. Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D523.

C. Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D523.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product. Include preparation requirements and application instructions.

1. Indicate VOC content.

B. Sustainable Design Submittals:

1. Product Data: For paints and coatings, indicating VOC content.
2. Laboratory Test Reports: For paints and coatings, indicating compliance with requirements for low-emitting materials.
3. Environmental Product Declaration (EPD): For each product.

C. Samples for Verification: For each type of coating system and each color and gloss of topcoat indicated.

1. Submit Samples on actual substrate material to be coated, 8 inches square.
2. Apply coats on Samples in steps to show each coat required for system.
3. Label each coat of each Sample.
4. Label each Sample for location and application area.

D. Product List: Use same designations indicated on Drawings and in Exterior High-Performance Coating Schedule and Interior High-Performance Coating Schedule. Include color designations and product runs (batch numbers).

1.4 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same production run, (batch number) that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Coatings: 5 percent, but not less than 1 gal. of each material and color applied.

1.5 QUALITY ASSURANCE

A. Mockups: Apply mockups of each coating system indicated to verify preliminary selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.

1. Architect will select one surface to represent surfaces and conditions for application of each coating system.

a. Wall and Ceiling Surfaces: Provide samples of at least 100 sq. ft..
b. Other Items: Architect will designate items or areas required.

2. Final approval of color selections will be based on mockups.

a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Architect at no added cost to Owner.

3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.

1. Maintain containers in clean condition, free of foreign materials and residue.
2. Remove rags and waste from storage areas daily.

1.7 FIELD CONDITIONS

A. Apply coatings only when temperature of surfaces to be coated and ambient air temperatures are between 50 and 95 deg F.

B. Do not apply coatings when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.

C. Do not apply exterior coatings in snow, rain, fog, or mist.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Carboline, an RPM company.
2. PPG Protective and Marine Coatings.
3. Sherwin-Williams Company Protective and Marine.
4. Tnemec Company Inc.

2.2 HIGH-PERFORMANCE COATINGS, GENERAL

A. Material Compatibility:

1. Materials for use within each paint system shall be compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. For each coat in a paint system, products shall be recommended in writing by topcoat manufacturers for use in paint system and on substrate indicated.
3. Products shall be of same manufacturer for each coat in a coating system.

B. VOC Content: For field applications that are inside the weatherproofing system, verify paints and coatings comply with VOC content limits of authorities having jurisdiction and the following VOC content limits:

1. Flat Paints and Coatings: 50 g/L.
2. Nonflat Paints and Coatings: 100 g/L.
3. High Gloss Paints and Coatings: 150 g/L.
4. Primers, Sealers, and Undercoaters: 100 g/L.

5. Rust-Preventive Coatings: 250 g/L.
6. Zinc-Rich Industrial Maintenance Primers: 100 g/L.
7. Pretreatment Wash Primers: 420 g/L.
8. Floor Coatings: 50 g/L.
9. Shellacs, Clear: 730 g/L.
10. Shellacs, Pigmented: 550 g/L.

C. Low-Emitting Materials: For field applications that are inside the weatherproofing system, verify 90 percent of paints and coatings comply with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

D. Colors: As preselected and indicated in the Finish Schedule on the Drawings. The use of a manufacturer's proprietary color name is not intended to exclude comparable products by other listed manufacturers which are specially formulated to match the named manufacturer's color.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

1. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:

a. Concrete: 12 percent.
b. Masonry (Clay and CMU): 12 percent.
c. Gypsum Board: 12 percent.

2. Steel Substrates: Confirm shop preparation and prime coats comply with minimum cleaning methods and primers recommended by coating manufacturer and specified in this Section.

B. Gypsum Board Substrates: Verify that finishing compound is sanded smooth.

C. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.

D. Proceed with coating application only after unsatisfactory conditions have been corrected.

1. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Comply with manufacturer's written instructions applicable to substrates and coating systems indicated.

B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted.

1. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
2. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed.
3. Remove surface-applied protection if any.

C. Clean substrates of substances that could impair bond of coatings, including dust, dirt, oil, grease, and incompatible paints and encapsulants.

1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce coating systems indicated.

D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk.

1. Do not coat surfaces if moisture content or alkalinity of surfaces to be coated exceeds that permitted in manufacturer's written instructions.

E. Masonry Substrates: Remove efflorescence and chalk.

1. Do not coat surfaces if moisture content, alkalinity of surfaces, or alkalinity of mortar joints exceeds that permitted in manufacturer's written instructions.

F. Steel Substrates: Remove rust, loose mill scale, and shop primer if any.

1. Clean using methods recommended in writing by manufacturer.

G. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and areas where shop paint is abraded. Paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.

H. Galvanized-Steel Substrates: Remove grease and oil residue from galvanized sheet metal by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied coatings.

I. Aluminum Substrates: Remove loose surface oxidation.

3.3 APPLICATION

A. Apply high-performance coatings in accordance with manufacturer's written instructions.

1. Use applicators and techniques suited for coating and substrate indicated.
2. Coat surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, coat surfaces behind permanently fixed equipment or furniture with prime coat only.
3. Coat backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
4. Do not apply coatings over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.

B. If undercoats or other conditions show through final coat, apply additional coats until cured film has a uniform coating finish, color, and appearance.

C. Apply coatings to produce surface films without cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections. Produce sharp glass lines and color breaks.

3.4 FIELD QUALITY TESTING AND INSPECTION

A. Dry Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and test coatings for dry film thickness.

1. Contractor shall touch up and restore coated surfaces damaged by testing.
2. If test results show that dry film thickness of applied coating does not comply with coating manufacturer's written instructions, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with coating manufacturer's written instructions.

3.5 CLEANING AND PROTECTION

A. After completing coating application, clean spattered surfaces. Remove spattered coatings by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

B. Protect work of other trades against damage from coating operation. Correct damage to work of other trades by cleaning, repairing, replacing, and recoating, as approved by Architect, and leave in an undamaged condition.

C. At completion of construction activities of other trades, touch up and restore damaged or defaced coated surfaces.

3.6 EXTERIOR HIGH-PERFORMANCE COATING SCHEDULE

A. Concrete Substrates, Vertical Surfaces: At all exterior concrete surfaces indicated to receive paint.

1. Elastomeric System:

a. Surface Preparation: SSPC-SP 13/NACE 6. Clean and dry.
b. Prime Coat: As recommended in writing by topcoat manufacturer.
c. Intermediate Coat: Elastomeric, matching topcoat.
d. Topcoat: Elastomeric, pigmented, exterior, water-based, flat coating.

1) Carboline: Flexxide.
2) PPG: Perma Crete Pitt Flex Elastomeric Coating 4-110.
3) Sherwin-Williams; Conflex XL.
4) Tnemec; Series 156 – Enviro-Crete.

B. CMU Substrates: At all exterior CMU locations scheduled to receive paint unless otherwise indicated.

1. Pigmented Polyurethane over High-Build Epoxy System:

a. Surface Preparation: Clean and dry.

b. Block Filler: Waterborne, cementitious, acrylic.

1) Carboline: Sanitile 500 Waterborne Epoxy Block Filler.
2) PPG: Amercoat 965 Acrylic Blockfiller.
3) Sherwin-Williams; Cement-Plex 875 Blockfiller.
4) Tnemec; Series 130 – Envirofill.

c. Primer: To match intermediate coat.
d. Intermediate Coat: Two-part, waterborne epoxy.

1) Carboline: Sanitile Waterborne Epoxy.
2) PPG: Aquapon WB 98-1 Series Catalyzed Water Based Epoxy.
3) Sherwin-Williams; Pro Industrial Water Based Catalyzed Epoxy, B73-300.
4) Tnemec; Series 287 – Enviro-Pox.

e. Topcoat: Two-part, aliphatic polyurethane, gloss.

1) Carboline: Carbothane 134WB.
2) PPG: Pitthane Ultra Gloss Polyurethane 95-812 Series.
3) Sherwin-Williams; Waterbased Acrolon 100.
4) Tnemec; Series 297 – Enviro-Glaze.

C. Steel Substrates:

1. Pigmented Polyurethane over Epoxy Zinc-Rich Primer System: At all miscellaneous metals unless noted otherwise.

a. Surface Preparation: SSPC-SP 6/NACE 3.
b. Prime Coat: Primer, zinc rich, epoxy.

1) Carboline: CarboZinc 859 VOC.
2) PPG: Amercoat 68HS VOC Zinc Rich Epoxy.
3) Sherwin-Williams; Zinc-Clad III HS 100 or Corothane I – GalvaPac Zinc Primer 1K.
4) Tnemec; Series 94-H20 – Hydro-Zinc.

c. Intermediate Coat: Epoxy, high build, low gloss.

1) Carboline: CarboGuard 890 VOC.
2) PPG: Amerlock 2 VOC.
3) Sherwin-Williams; MacroPoxy 646-100.
4) Tnemec; Series L69 – Hi-Build Epoxoline II.

d. Topcoat: Polyurethane, two-component, pigmented, gloss (MPI Gloss Level 6).

1) Carboline: Carbothane 134 VOC.
2) PPG: Amercoat 450H Gloss Aliphatic Polyurethane.
3) Sherwin-Williams; Hi-Solids Polyurethane 100.
4) Tnemec; Series 1095 – Endura-Shield.

2. Polysiloxane over Epoxy Zinc-Rich Primer and High Build Epoxy System: At all exterior exposed structural steel unless noted otherwise.

a. Surface Preparation: SSPC-SP 6/NACE 3.
b. Prime Coat: Primer, zinc rich, epoxy.

1) Carboline: CarboZinc 859 VOC.
2) PPG: Amercoat 68HS VOC Zinc Rich Epoxy.
3) Sherwin-Williams; Zinc-Clad III HS 100 or Corothane I – GalvaPac Zinc Primer 1K.
4) Tnemec; Series 94-H20 – Hydro-Zinc.

c. Intermediate Coat: Epoxy, high build, low gloss.

1) Carboline: CarboGuard 890 VOC.
2) PPG: Amerlock 2 VOC.
3) Sherwin-Williams; MacroPoxy 646-100.
4) Tnemec; Series L69 – Hi-Build Epoxoline II.

d. Topcoat: Polysiloxane or Hybrid Polyurethane, two-component, pigmented, gloss (MPI Gloss Level 6).

1) Carboline: Carboxane 2100FC.
2) PPG: PSX 805 Satin Engineered Polysiloxane.
3) Sherwin-Williams; Polysiloxane XLE-80.
4) Tnemec; Series 750 UVX.

D. Galvanized-Metal Substrates:

1. Pigmented Polyurethane over Epoxy Primer System: At all exterior exposed galvanized metal.

a. Surface Preparation: Abrasive blast or chemically cleaned and etched.
b. Prime Coat: Primer not required; intermediate coat is self-priming.
c. Intermediate Coat: Epoxy, high build, low gloss.

1) Carboline: Galoseal WB.
2) PPG: Amerlock 2 VOC.
3) Sherwin-Williams; MacroPoxy 646-100.
4) Tnemec; Series L69 – Hi-Build Epoxoline II.

d. Topcoat: Polyurethane, two-component, pigmented, gloss (MPI Gloss Level 6).

1) Carboline: Carbothane 134 VOC.
2) PPG: Amercoat 450H Gloss Aliphatic Polyurethane.
3) Sherwin-Williams; Hi-Solids Polyurethane 100.
4) Tnemec; Series 1095 – Endura-Shield.

E. Portland Cement Plaster (Stucco) Substrates:

1. Latex System:

a. Prime Coat: Exterior, alkali-resistant, water-based primer.

1) Benjamin Moore: Ultra Spec; Interior/Exterior 100% Acrylic Sealer, K608
2) PPG: Perma-Crete Interior/Exterior Alkali Resistant Primer, 4-603XI

3) Sherwin Williams: Loxon Concrete and Masonry Primer/Sealer, A24W8300

b. Intermediate Coat: Matching topcoat.
c. Topcoat: Exterior latex paint, flat.

1) Benjamin Moore: Ultra Spec; Exterior Flat Acrylic, N447/K447
2) PPG: Speedhide Exterior 100% Acrylic Latex Flat, 6-610XI
3) Sherwin Williams: A-100 Exterior Latex Flat, A06W00151

3.7 INTERIOR HIGH-PERFORMANCE COATING SCHEDULE

A. Concrete Substrates, Horizontal Surfaces, Pavement Marking:

1. Latex Waterborne Emulsion: At all interior pavement marking on concrete.

a. Surface Preparation: Clean, dry, and in sound condition. Remove all oil, dust, grease, dirt, loose rust, and other foreign material to ensure adequate adhesion.
b. Topcoat: Latex, waterborne emulsion:

1) PPG: Zoneline, 11-54.
2) Sherwin-Williams: Protective and Marine Coatings, Setfast Low VOC Acrylic, TM2161.

B. Steel Substrates:

1. Pigmented Polyurethane over High-Build Epoxy System: At all interior exposed structural steel and miscellaneous metal fabrications.

a. Surface Preparation: SSPC-SP 6/NACE 3.
b. Prime Coat: Primer, zinc rich, epoxy.

1) Carboline: CarboZinc 859 VOC.
2) PPG: Amercoat 68HS VOC Zinc Rich Epoxy.
3) Sherwin-Williams; Zinc-Clad III HS 100.
4) Tnemec; Series 94-H20 – Hydro-Zinc.

c. Intermediate Coat: Epoxy, high build, low gloss.

1) Carboline: CarboGuard 890 VOC.
2) PPG: Amerlock 2 VOC.
3) Sherwin-Williams; MacroPoxy 646-100.
4) Tnemec; Series L69 – Hi-Build Epoxoline II.

d. Topcoat: Polyurethane, two-component, pigmented, gloss (MPI Gloss Level 6).

1) Carboline: Carbothane 134 MC.
2) PPG: Amershield VOC.
3) Sherwin-Williams; Hi-Solids Polyurethane 100.
4) Tnemec; Series 1095 – Endura-Shield.

C. Galvanized-Metal Substrates:

1. Pigmented Polyurethane System: At all interior exposed galvanized metal.

    a. Surface Preparation: Abrasive blast or chemically cleaned and etched.
    b. Prime Coat: Primer not required; intermediate coat is self-priming.
    c. Intermediate Coat: Epoxy, high build, low gloss.

        1) Carboline: Galoseal
        2) PPG: Amerlock 2 VOC.
        3) Sherwin-Williams; MacroPoxy 646-100.
        4) Tnemec; Series L69 – Hi-Build Epoxoline II.

    d. Topcoat: Polyurethane, two-component, pigmented, gloss (MPI Gloss Level 6).

        1) Carboline: Carbothane 134 MC.
        2) PPG: Amershield VOC.
        3) Sherwin-Williams; Hi-Solids Polyurethane 100.
        4) Tnemec; Series 1095 – Endura-Shield.

D. Gypsum Board Substrates:

1. Epoxy/Polyurethane System: At all gypsum board surfaces in janitor's closets, kitchens, locker rooms, and toilet rooms with showers.

    a. Surface Preparation: Level 5 finish.
    b. Prime Coat: Primer sealer, modified polyamine epoxy, interior.

        1) Carboline: Sanitile 120.
        2) PPG: Amerlock 2 VOC Epoxy Primer.
        3) Sherwin-Williams: MacroPoxy 646-100.
        4) Tnemec: Series 201– Epoxoprime.

    c. Intermediate Coat: to match topcoat
    d. Topcoat: Two-part, waterborne epoxy.

        1) Carboline: Sanitile 555 VOC.
        2) PPG: Aquapon WB 98-1 Series Catalyzed Water Based Epoxy.
        3) Sherwin-Williams: Pro Industrial Water Based Catalyzed Epoxy, B73-300.
        4) Tnemec: Series 287 – Enviro-Pox.

END OF SECTION

PROJECT MANUAL FOR CONSTRUCTION OF

SUPREME COURT OF MARYLAND

Rowe Boulevard
Annapolis, MD
Anne Arundel County
DGS Project #BA-688-200-001
Project Classification H

PROJECT SPECIFICATIONS

Volume 2 of 4: Divisions 10 - 23

Issue for Bid
December 1, 2023

DEPARTMENT OF GENERAL SERVICES
Atif Chaudhry, Secretary
301 West Preston Street, Room 1405
Baltimore, MD 21201

Board of Public Works
Wes Moore, Governor
Brooke Elizabeth Lierman, Comptroller
Dereck E. Davis, Treasurer

Maryland
DEPARTMENT OF GENERAL SERVICES

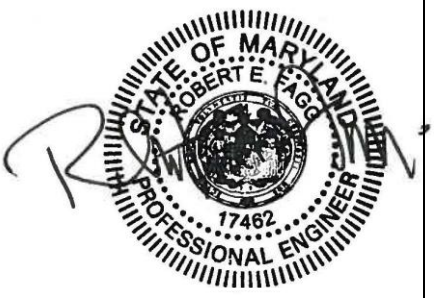
SUPREME COURT OF MARYLAND

FENTRESS ARCHITECTS

"Minority Business Enterprises are encouraged to respond to this solicitation."

This page is intentionally left blank.

SECTION 00 01 07 - SEALS PAGE

		
ARCHITECT OF RECORD	CIVIL ENGINEER	STRUCTURAL ENGINEER
 12/1/2023	 12/1/2023	 12/1/2023
FIRE PROTECTION	PLUMBING ENGINEER	MECHANICAL ENGINEER
 12/1/2023	 12/1/2023	
ELECTRICAL ENGINEER	TECHNOLOGY & AV ENGINEER	LANDSCAPE ARCHITECT

END OF SEALS PAGE

This page is intentionally left blank.

SECTION 00 01 10 - TABLE OF CONTENTS

Issue No.	**Issue Title**	**Issue Date**
Issue 1:	Issue for Bid	December 1, 2023

Legend:
X = First Issue for Bid
O = Reissue (unchanged)
R = Revised for this Package
W = Withdrawn
-- = Not Reissued for this Package

SECTION NUMBER	SECTION TITLE	Author	ISSUE NUMBER							
			1	2	3	4	5	6	7	8
DIVISION 00 - PROCUREMENT AND CONTRACTING REQUIREMENTS										
00 01 07	Seals Page	FA	X							
00 01 10	Table of Contents	FA	X							
DIVISION 00 – PROCUREMENT AND CONTRACTING REQUIREMENTS										
Division 00	Procurement and Contracting Requirements	DGS	X							
DIVISION 01 - GENERAL REQUIREMENTS										
01 10 00	Summary	FA	X							
01 21 00	Allowances	FA	X							
01 22 00	Unit Prices	FA	X							
01 23 00	Alternates	FA	X							
01 25 00	Substitution Procedures	FA	X							
01 26 00	Contract Modification Procedures	FA	X							
01 29 00	Payment Procedures	FA	X							
01 31 00	Project Management and Coordination	FA	X							
01 31 00A	Digital Data Licensing and Indemnification Exhibit – Appendix A	FA	X							
01 32 00	Construction Progress Documentation	FA	X							

SECTION NUMBER	SECTION TITLE	Author	ISSUE NUMBER							
			1	2	3	4	5	6	7	8
01 33 00	Submittal Procedures	FA	X							
01 40 00	Quality Requirements	FA	X							
01 42 00	References	FA	X							
01 43 39	Mockups	FA	X							
01 50 00	Temporary Facilities and Controls	FA	X							
01 50 10	Temporary Facilities and Controls - State Field Office	FA	X							
01 56 39	Temporary Tree and Plant Protection	AMT	X							
01 60 00	Product Requirements	FA	X							
01 73 00	Execution	FA	X							
01 74 19	Construction Waste Management and Disposal	FA	X							
01 74 19 EVA	Form CWM-1: Construction Waste Identification	FA	X							
01 74 19 EVB	Form CWM-2: Demolition Waste Identification	FA	X							
01 74 19 EVC	Form CWM-3: Construction Waste Reduction Work Plan	FA	X							
01 74 19 EVD	Form CWM-4: Demolition Waste Reduction Work Plan	FA	X							
01 74 19 EVE	Form CWM-5: Cost/Revenue Analysis of Construction Waste Reduction Work Plan	FA	X							
01 74 19 EVF	Form CWM-6: Cost/Revenue Analysis of Demolition Waste Reduction Work Plan	FA	X							
01 74 19 EVG	Form CWM-7: Construction Waste Reduction Progress Report	FA	X							
01 74 19 EVH	Form CWM-8: Demolition Waste Reduction Progress Report	FA	X							
01 77 00	Closeout Procedures	FA	X							
01 78 23	Operation and Maintenance Data	FA	X							
01 78 39	Project Record Documents	FA	X							
01 79 00	Demonstration and Training	FA	X							
01 81 13.14	Sustainable Design Requirements – LEED v4 BD+C, New Construction	FA	X							
01 81 13.14A	LEED Matrix - Appendix A	FA	X							

SECTION NUMBER	SECTION TITLE	Author	ISSUE NUMBER							
			1	2	3	4	5	6	7	8
01 81 13.14B	LEED Scorecard - Appendix B	FA	X							
01 81 13.14C	LEEDv4.1 Materials Submittal Form - Appendix C	FA	X							
01 91 13	General Commissioning Requirements [to be provided at later date]	DGS								
DIVISION 02 – EXISTING CONDITIONS										
02 41 19	Selective Demolition	FA	X							
DIVISION 03 – CONCRETE										
03 10 00	Concrete Forming and Accessories	HFA	X							
03 30 00	Cast-in-Place Concrete	HFA	X							
03 45 00	Precast Architectural Concrete	FA	X							
DIVISION 04 – MASONRY										
04 01 40.99	Relocation Reuse and Restoration of Latrobe Marble Columns	FA	X							
04 22 00	Concrete Unit Masonry	FA	X							
DIVISION 05 – METALS										
05 05 19	Post Installed Anchors	HFA	X							
05 12 00	Structural Steel Framing	HFA	X							
05 31 00	Steel Decking	HFA	X							
05 40 00	Cold-Formed Metal Framing	FA	X							
05 50 00	Metal Fabrications	FA	X							
05 51 13	Metal Pan Stairs	FA	X							
05 51 19	Metal Grating Stairs	FA	X							
05 52 13	Pipe and Tube Railings	FA	X							

SECTION NUMBER	SECTION TITLE	Author	ISSUE NUMBER							
			1	2	3	4	5	6	7	8
05 53 13	Bar Gratings	HFA	X							
05 58 13	Column Covers	FA	X							
05 70 00	Decorative Metal	FA	X							
05 71 00	Decorative Metal Stairs	FA	X							
05 73 00	Decorative Metal Railings	FA	X							
05 73 13	Glazed Decorative Metal Railings	FA	X							
05 75 00	Decorative Formed Metal	FA	X							
DIVISION 06 – WOOD, PLASTICS, AND COMPOSITES										
06 01 40.99	Relocation, Reuse, and Restoration of Historic Courtroom Woodwork	FA	X							
06 10 00	Rough Carpentry	FA	X							
06 16 00	Sheathing	FA	X							
06 40 23	Interior Architectural Woodwork	FA	X							
06 41 13	Wood-Veneer-Faced Architectural Cabinets	FA	X							
06 41 16	Plastic-Laminate-Clad Architectural Cabinets	FA	X							
06 42 14	Stile and Rail Wood Paneling	FA	X							
06 44 00	Ornamental Woodwork	FA	X							
06 64 00	Plastic Paneling	FA	X							
06 83 13	Fiber-Reinforced Plastic Paneling	FA	X							
DIVISION 07 – THERMAL AND MOISTURE PROTECTION										
07 05 43.13	Rainscreen Cladding Support Systems	FA	X							
07 11 13	Bituminous Dampproofing	FA	X							
07 13 26	Self-Adhering Sheet Waterproofing	FA	X							
07 14 13	Hot Fluid-Applied Rubberized Asphalt Waterproofing	FA	X							

SECTION NUMBER	SECTION TITLE	Author	ISSUE NUMBER							
			1	2	3	4	5	6	7	8
07 16 16	Crystalline Waterproofing	FA	X							
07 18 00	Traffic Coatings	FA	X							
07 19 00	Water Repellents	FA	X							
07 21 00	Thermal Insulation	FA	X							
07 21 19	Foamed-In-Place Insulation	FA	X							
07 27 13	Modified Bituminous Sheet Air Barriers	FA	X							
07 42 13.13	Formed Metal Wall Panels	FA	X							
07 54 19	Polyvinyl-Chloride (PVC) Roofing	FA	X							
07 62 00	Sheet Metal Flashing and Trim	FA	X							
07 72 00	Roof Accessories	FA	X							
07 72 73	Vegetated Roof Systems	FA	X							
07 81 00	Applied Fire Protection	FA	X							
07 84 13	Penetration Firestopping	FA	X							
07 84 43	Joint Firestopping	FA	X							
07 92 00	Joint Sealants	FA	X							
07 92 19	Acoustical Joint Sealants	FA	X							
DIVISION 08 – OPENINGS										
08 11 13	Hollow Metal Doors and Frames	FA	X							
08 14 16	Flush Wood Doors	FA	X							
08 14 33	Stile and Rail Wood Doors	FA	X							
08 31 13	Access Doors and Frames	FA	X							
08 33 23	Overhead Coiling Doors	FA	X							
08 33 43	Overhead Coiling Smoke Curtains	FA	X							
08 41 26.23	Interior All-Glass Entrances	FA	X							

SECTION NUMBER	SECTION TITLE	Author	ISSUE NUMBER							
			1	2	3	4	5	6	7	8
08 44 13	Glazed Aluminum Curtain Walls	FA	X							
08 56 53	Security Windows	FA	X							
08 63 00	Metal-Framed Skylights	FA	X							
08 71 00	Door Hardware	DMK/FA	X							
08 71 13	Power Door Operators	FA	X							
08 75 16	Window Operators	FA	X							
08 80 00	Glazing	FA	X							
08 81 13	Decorative Glass Glazing	FA	X							
08 83 00	Mirrors	FA	X							
08 88 53	Security Glazing	FA	X							
08 91 19	Fixed Louvers	FA	X							
DIVISION 09 – FINISHES										
09 05 61.13	Moisture Vapor Emission Control	FA	X							
09 21 16.23	Gypsum Board Shaft Wall Assemblies	FA	X							
09 22 16	Non-Structural Metal Framing	FA	X							
09 23 13	Acoustical Gypsum Plastering	FA	X							
09 24 00	Cement Plastering	FA	X							
09 27 13	Glass-Fiber-Reinforced Gypsum Fabrications	FA	X							
09 29 00	Gypsum Board	FA	X							
09 30 13	Ceramic Tiling	FA	X							
09 51 13	Acoustical Panel Ceilings	FA	X							
09 64 00	Wood Flooring	FA	X							
09 65 13	Resilient Base and Accessories	FA	X							
09 65 19	Resilient Tile Flooring	FA	X							

SECTION NUMBER	SECTION TITLE	Author	ISSUE NUMBER							
			1	2	3	4	5	6	7	8
09 65 36	Static-Control Resilient Flooring	FA	X							
09 65 66	Resilient Athletic Flooring	FA	X							
09 66 23	Resinous Matrix Terrazzo Flooring	FA	X							
09 68 13	Tile Carpeting	FA	X							
09 75 13	Stone Wall Facing	FA	X							
09 75 23	Simulated Stone Wall Facing	FA	X							
09 84 33	Sound-Absorbing Wall Units	FA	X							
09 91 23	Interior Painting	FA	X							
09 96 11	High-Performance Coatings (Proprietary Specification)	FA	X							
DIVISION 10 – SPECIALTIES										
10 12 00	Display Cases	FA	X							
10 14 00	Signage	FA	X							
10 21 13.17	Phenolic-Core Toilet Compartments	FA	X							
10 22 13	Wire Mesh Partitions	FA	X							
10 22 39	Folding Panel Partitions	FA	X							
10 26 00	Wall and Door Protection	FA	X							
10 26 41	Bullet Resistant Panels	FA	X							
10 28 00	Toilet, Bath, and Laundry Accessories	FA	X							
10 43 13	Defibrillator Cabinets	FA	X							
10 44 13	Fire Protection Cabinets	FA	X							
10 44 16	Fire Extinguishers	FA	X							
10 45 13	Photoluminescent Egress Path Markings	FA	X							
10 51 13	Metal Lockers	FA	X							
10 51 16	Wood Lockers	FA	X							

SECTION NUMBER	SECTION TITLE	Author	ISSUE NUMBER							
			1	2	3	4	5	6	7	8
10 51 23	Plastic-Laminate-Clad Lockers	FA	X							
10 56 26	Mobile Storage Shelving	FA	X							
10 81 13	Bird Control Devices	FA	X							
DIVISION 11 – EQUIPMENT										
11 12 00	Vehicle Access Control Systems	M2H	X							
11 13 19	Stationary Loading Dock Equipment	FA	X							
11 19 16	Detention Gun Lockers	FA	X							
11 30 13	Residential Appliances	FA	X							
11 81 31	Facility Fall Protection and Facade Access Equipment	FA	X							
11 81 33	Mobile Scissor Lifts	FA	X							
DIVISION 12 – FURNISHINGS										
12 24 13	Roller Window Shades	FA	X							
12 36 23.13	Plastic-Laminate-Clad Countertops	FA	X							
12 36 61.19	Quartz Agglomerate Countertops	FA	X							
12 93 00	Site Furnishings	RHI	X							
DIVISION 14 – CONVEYING EQUIPMENT										
14 21 23.16	Machine Room-Less Electric Traction Passenger Elevators	FA	X							
14 27 00	Custom Elevator Cabs and Doors	FA	X							
DIVISION 21 – FIRE SUPPRESSION										
21 05 00	Common Work Results For Fire Suppression	ME-E	X							
21 08 00	Commissioning Of Fire Suppression System	ME-E	X							

SECTION NUMBER	SECTION TITLE	Author	ISSUE NUMBER							
			1	2	3	4	5	6	7	8
21 13 00	Fire Suppression Sprinkler Systems	ME-E	X							
21 13 19	Preaction Suppression Systems	ME-E	X							
21 90 00	Fire Suppression System Project Closeout	ME-E	X							
DIVISION 22 – PLUMBING										
22 00 00	Basic Plumbing Requirements	WFT	X							
22 05 13	Common Motor Requirements for Plumbing Equipment	WFT	X							
22 05 16	Expansion Fittings and Loops for Plumbing Piping	WFT	X							
22 05 17	Sleeves and Sleeve Seals for Plumbing Piping	WFT	X							
22 05 18	Escutcheons for Plumbing Piping	WFT	X							
22 05 19	Meters and Gages for Plumbing Piping	WFT	X							
22 05 23.12	Ball Valves for Plumbing Piping	WFT	X							
22 05 23.13	Butterfly Valves for Plumbing Piping	WFT	X							
22 05 23.14	Check Valves for Plumbing Piping	WFT	X							
22 05 23.15	Gate Valves for Plumbing Piping	WFT	X							
22 05 29	Hangers and Supports for Plumbing Piping and Equipment	WFT	X							
22 05 48.13	Vibration Controls for Plumbing Piping and Equipment	WFT	X							
22 05 53	Identification for Plumbing Piping and Equipment	WFT	X							
22 05 93	Testing, Adjusting, and Balancing for Plumbing	WFT	X							
22 07 16	Plumbing Equipment Insulation	WFT	X							
22 07 19	Plumbing Piping Insulation	WFT	X							
22 11 16	Domestic Water Piping	WFT	X							
22 11 19	Domestic Water Piping Specialties	WFT	X							
22 11 23.13	Domestic Water Packaged Booster Pumps	WFT	X							
22 11 23.21	Inline, Domestic-Water Pumps	WFT	X							

SECTION NUMBER	SECTION TITLE	Author	ISSUE NUMBER							
			1	2	3	4	5	6	7	8
22 12 23.11	Facility Indoor Potable Water Storage Tanks	WFT	X							
22 13 13	Facility Sanitary Sewers	AMT	X							
22 13 16	Sanitary Waste and Vent Piping	WFT	X							
22 13 19	Sanitary Waste Piping Specialties	WFT	X							
22 13 19.13	Sanitary Drains	WFT	X							
22 13 23	Sanitary Waste Interceptors	WFT	X							
22 14 13	Facility Storm Drainage Piping	WFT	X							
22 14 23	Storm Drainage Piping Specialties	WFT	X							
22 14 29	Sump Pumps	WFT	X							
22 32 00	Domestic Water Filtration Equipment	WFT	X							
22 33 00	Electric, Domestic-Water Heaters	WFT	X							
22 42 13.13	Commercial Water Closets	WFT	X							
22 42 13.16	Commercial Urinals	WFT	X							
22 42 16.13	Commercial Lavatories	WFT	X							
22 42 16.16	Commercial Sinks	WFT	X							
22 42 23	Commercial Showers	WFT	X							
22 45 00	Emergency Plumbing Fixtures	WFT	X							
22 47 16	Pressure Water Coolers	WFT	X							
DIVISION 23 – HEATING, VENTILATING, AND AIR CONDITIONING (HVAC) *Refer To Alternates List For Applicable Sections										
23 05 01*	Mechanical and Electrical Coordination 23 05 01 and 26 05 01	ME-E	X							
23 05 02	Basic Mechanical Requirements	ME-E	X							
23 05 03	Basic Mechanical Materials and Methods	ME-E	X							
23 05 04	Corrosion Protection from Humid Salt-Laden Outdoor Air	ME-E	X							
23 05 13	Motors and Starters	ME-E	X							

SECTION NUMBER	SECTION TITLE	Author	ISSUE NUMBER							
			1	2	3	4	5	6	7	8
23 05 21	Pipe and Pipe Fittings	ME-E	X							
23 05 22	Piping Accessories	ME-E	X							
23 05 23	Valves	ME-E	X							
23 05 29	Pipe Supports and Anchors	ME-E	X							
23 05 30	Electronic Speed Controllers	ME-E	X							
23 05 48	Vibration Control	ME-E	X							
23 05 53	Mechanical Identification	ME-E	X							
23 05 93	Test-Adjust-Balance	ME-E	X							
23 07 00	Mechanical Insulation	ME-E	X							
23 08 00	Building Mechanical System Commissioning	ME-E	X							
23 08 01	Commissioning Agent Requirements	ME-E	X							
23 09 00	Building Automation and Automatic Temperature Control Systems	ME-E	X							
23 09 02	Life Safety Systems	ME-E	X							
23 09 03*	Smoke Management 23 09 03 and 28 46 10	ME-E	X							
23 21 13	Hydronic Piping	ME-E	X							
23 21 23	HVAC Pumps	ME-E	X							
23 23 00	Refrigerant Piping	ME-E	X							
23 25 13	HVAC System Chemical Treatment	ME-E	X							
23 31 13	Ductwork	ME-E	X							
23 33 00	Ductwork Accessories	ME-E	X							
23 34 00	Fans	ME-E	X							
23 36 00	Air Terminal Units	ME-E	X							
23 37 00	Air Inlets and Outlets	ME-E	X							
23 40 00	Air Cleaning	ME-E	X							
23 52 00	Boilers	ME-E	X							

SECTION NUMBER	SECTION TITLE	Author	ISSUE NUMBER							
			1	2	3	4	5	6	7	8
23 64 23	Air Cooled Scroll Heat Pump Water Chillers	ME-E	X							
23 73 13	Air Handling Units with Coil	ME-E	X							
23 73 24	Split System Dx Air Handling Units	ME-E	X							
23 81 23	Electronic Room Air Conditioning Unit	ME-E	X							
23 81 26	Split System Air Conditioners	ME-E	X							
23 81 29	Variable Refrigerant Flow HVAC Systems	ME-E	X							
23 82 16	Air Coils	ME-E	X							
23 82 19	Fan Coil Units	ME-E	X							
23 82 39	Heating Terminal Units	ME-E	X							
23 84 13	Humidifiers	ME-E	X							
23 90 00	Project Closeout	ME-E	X							
DIVISION 26 – ELECTRICAL *Refer To Alternates List For Applicable Sections										
26 05 00	Electrical Requirements	ME-E	X							
26 05 01*	Mechanical and Electrical Coordination 23 05 01 and 26 05 01	ME-E	X							
26 05 02	Basic Material and Methods	ME-E	X							
26 05 03	Manufacturers	ME-E	X							
26 05 10	Testing	ME-E	X							
26 05 19	Electrical Power Conductors and Cables	ME-E	X							
26 05 26	Grounding and Bonding	ME-E	X							
26 05 29	Hangers and Supports	ME-E	X							
26 05 33	Raceways and Boxes	ME-E	X							
26 05 43	Underground Ducts, Raceways and Manholes	ME-E	X							
26 05 48	Vibration and Seismic Controls	ME-E	X							

SECTION NUMBER	SECTION TITLE	Author	ISSUE NUMBER							
			1	2	3	4	5	6	7	8
26 05 53	Identification	ME-E	X							
26 05 73	Electrical Studies	ME-E	X							
26 09 13	Electrical Power Monitoring	ME-E	X							
26 09 36	Modular Dimming Controls	MCLA	X							
26 09 43	Lighting Control System	ME-E	X							
26 22 13	Low-Voltage Distribution Transformers	ME-E	X							
26 24 12	Utility Service Connection Cabinets	ME-E	X							
26 24 13	Distribution Switchboards	ME-E	X							
26 24 16	Panelboards	ME-E	X							
26 25 00	Enclosed Bus Assemblies	ME-E	X							
26 27 26	Wiring Devices	ME-E	X							
26 27 29	Electric Vehicle Charging Systems	ME-E	X							
26 28 16	Enclosed Switches, Fuses and Circuit Breakers	ME-E	X							
26 32 13	Diesel-Engine Driven Generator Sets	ME-E	X							
26 36 23	Automatic Transfer Switches	ME-E	X							
26 41 13	Lightning Protection for Structures	ME-E	X							
26 43 13	Surge Protective Device (SPD) (Selenium Enhanced)	ME-E	X							
26 43 14	Surge Protective Device (SPD)	ME-E	X							
26 51 00	Lighting Fixtures	MCLA	X							
26 56 13	Poles and Standards	ME-E	X							
26 90 00	Project Closeout	ME-E	X							
DIVISION 27 – COMMUNICATIONS										
27 05 00	Common Work Results for Communications	ME-E	X							
27 05 26	Telecommunications Grounding and Bonding	ME-E	X							

SECTION NUMBER	SECTION TITLE	Author	ISSUE NUMBER							
			1	2	3	4	5	6	7	8
27 05 33	Telecommunications Raceways and Boxes	ME-E	X							
27 05 36	Cable Trays	ME-E	X							
27 11 00	Communications Equipment Room Fit-Out	ME-E	X							
27 13 13	Communications Copper Backbone Cabling	ME-E	X							
27 13 23	Communications Optical Fiber Backbone Cabling	ME-E	X							
27 15 00	Communications Horizontal Cabling	ME-E	X							
27 41 00	Audio Visual Systems	ME-E	X							
27 53 20	Distributed Antenna Systems (DAS) General Requirements	ME-E	X							
DIVISION 28 – ELECTRONIC SAFETY AND SECURITY *Refer To Alternates List For Applicable Sections										
28 05 00.10	Common Work Results for Electronic Security	M2H	X							
28 05 09.10	Surge Protection for Electronic Security	M2H	X							
28 05 11	Cyber Security for Electronic Security	M2H	X							
28 05 13	Conductors and Cables for Electronic Security	M2H	X							
28 05 13.10	Servers, Workstations, and Storage for Electronic Security	M2H	X							
28 05 26.10	Grounding and Bonding for Electronic Security	M2H	X							
28 05 28.10	Pathways for Electronic Security	M2H	X							
28 05 29	Hangers and Supports for Communications Systems	M2H	X							
28 05 31.10	Communications Equipment for Electronic Security	M2H	X							
28 05 43	Underground Pathways for Elect Security	M2H	X							
28 05 44	Sleeves and Sleeve Seals for Electronic Security Pathways and Cabling	M2H	X							
28 08 00.10	Commissioning of Electronic Security	M2H	X							
28 11 16	Security Racks, Frames, and Enclosures	M2H	X							
28 13 00	Physical Access Control System	M2H	X							

SECTION NUMBER	SECTION TITLE	Author	ISSUE NUMBER							
			1	2	3	4	5	6	7	8
28 13 23	Optical Fiber Backbone Cabling for Electronic Security	M2H	X							
28 15 13	Security Copper Horizontal Cabling	M2H	X							
28 15 23	Intercom and Public Address Systems	M2H	X							
28 16 00	Intrusion Detection System	M2H	X							
28 23 00	Video Surveillance System	M2H	X							
28 46 00	Addressable Fire Alarm System	ME-E	X							
28 46 10*	Smoke Management 23 09 03 and 28 46 10	ME-E	X							
28 50 10	Area of Rescue Assistance System	ME-E	X							
28 50 20	Emergency Responder Radio System	ME-E	X							
28 51 00	Information Management & Presentation	M2H	X							
DIVISION 31 – EARTHWORK										
31 10 00	Site Clearing	AMT	X							
31 20 00	Earth Moving	AMT	X							
DIVISION 32 – EXTERIOR IMPROVEMENTS										
32 12 16	Asphalt Paving	AMT	X							
32 13 13	Concrete Paving	AMT	X							
32 13 13.33	Concrete Paving for Sidewalks	RHI	X							
32 13 73	Concrete Paving Joint Sealants	AMT	X							
32 13 73.33	Concrete Paving Joint Sealants for Sidewalks	RHI	X							
32 14 00	Unit Paving	FA	X							
32 17 13	Parking Bumpers	FA	X							
32 17 23	Pavement Markings	AMT	X							
32 17 26	Tactile Warning Surfacing	AMT	X							

SECTION NUMBER	SECTION TITLE	Author	ISSUE NUMBER							
			1	2	3	4	5	6	7	8
32 31 19	Decorative Metal Gates	FA	X							
32 91 15	Soil Preparation	RHI	X							
32 92 00	Lawns and Turfgrasses	RHI	X							
32 93 00	Exterior Plants	RHI	X							
32 96 00	Transplanting	RHI	X							
DIVISION 33 – UTILITIES										
33 14 15	Site Water Distribution Piping	AMT	X							
33 41 99	Stormwater Management	AMT	X							
33 42 00	Stormwater Conveyance	AMT	X							

END OF TABLE OF CONTENTS

SECTION 10 12 00 - DISPLAY CASES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Conditioned display cases.

1.2 DEFINITIONS

A. Display Case: Glazed cabinet with adjustable shelves.

1.3 ACTION SUBMITTALS

A. Product Data:

1. Display cases.

B. Product Data Submittals: For each product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for display cases. Include furnished specialties and accessories.
2. Include electrical characteristics for illuminated and conditioned display cases**.**

C. Sustainable Design Submittals:

1. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting materials.
2. Laboratory Test Reports: For composite wood products, indicating compliance with requirements for low-emitting materials.

D. Shop Drawings: For display cases.

1. Include plans, elevations, sections, and attachment details.
2. Include sections of typical trim members.
3. Include diagrams for wiring of illuminated and conditioned display cases.

E. Samples: For each exposed product and for each color and texture specified; not less than 8-1/2 by 11 inches for tackboard panels and 6 inches long for trim with factory finish.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For display cases to include in maintenance manuals.

1.5 FIELD CONDITIONS

A. Environmental Limitations: Do not deliver or install display cases for indoor installations until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, work above ceilings is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Obtain display cases from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: 25 or less.
2. Smoke-Developed Index: 50 or less.

B. Electrical Components: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.3 DISPLAY CASES EQ-2

A. Basis-of-Design Product: Subject to compliance with requirements, provide **Pinzhi Display; MW-8 Wall-Mounted Museum Display Cabinet** or a comparable product:

B. Wall Mounted Display Case: Factory-fabricated display case; with finished interior, operable glazed doors at front, and trim on face to cover edge of recessed opening.

1. Display Case Cabinet: As indicated on Drawings.

C. Glazed Sliding Doors: Tempered glass; unframed; with extruded-aluminum top and bottom track; supported on nylon or ball-bearing rollers; with plastic top guide and rubber bumpers. Equip each door with ground finger pull and adjustable cylinder lock with two keys.

D. Shelves: 6-mm-thick tempered glass; supported on adjustable shelf standards and supports.

1. Number of Shelves: As indicated on Drawings.

E. Adjustable Shelf Standards and Supports: Manufacturer’s standard. Provide standards extending full height of display case.

F. Back Panel: Of material indicated on Drawings.

G. Illumination System: Concealed top-lighting system consisting of fluorescent-strip fixtures. Include lamps and internal wiring with single concealed electrical connection to building system. Coordinate electrical characteristics with power supply provided.

1. Ballasts: Low-temperature, high-power-factor, low-energy, fluorescent lamp ballasts that comply with Certified Ballast Manufacturers Association standards and carry its label.

H. Temperature and Humidity Control: Manufacturer’s standard museum quality environmental control system capable of maintaining constant temperature and humidity in showcase in range appropriate for storing and displaying archival material including documents.

I. Size: As indicated on Drawings wide, by high, by deep.

2.4 MATERIALS

A. Composite Wood Products: Verify products are made using ultra-low-emitting formaldehyde resins, as defined in the California Air Resources Board's "Airborne Toxic Control Measure to Reduce Formaldehyde Emissions from Composite Wood Products," or are made with no added formaldehyde.

B. Hardboard: ANSI A135.4, tempered.

C. Fiberboard: ASTM C208.

D. Particleboard: ANSI A208.1, Grade M-1.

E. Hardwood Plywood: HPVA HP-1.

F. Polyester Fabric: Nondirectional weave, 100 percent polyester; weighing not less than 15 oz./sq. yd.; with flame-spread index of 25 or less when tested in accordance with ASTM E84.

G. Vinyl Fabric: ASTM F793/F793M, Type II, burlap weave; weighing not less than 13 oz./sq. yd.; with flame-spread index of 25 or less when tested in accordance with ASTM E84.

H. Extruded-Aluminum Bars and Shapes: ASTM B221, Alloy 6063.

I. Aluminum Tubing: ASTM B429/B429M, Alloy 6063.

J. Low-Iron Tempered Glass: ASTM C1048, Kind FT, Condition A, Type I, Class 1, Quality Q3; and with visible light transmission of not less than 91 percent.

K. High-Pressure Plastic Laminate: ISO 4586-3.

L. Fasteners: Provide screws, bolts, and other fastening devices made from same material as items being fastened, except provide hot-dip galvanized, stainless steel, or aluminum fasteners for exterior applications. Provide types, sizes, and lengths to suit installation conditions. Use security fasteners where exposed to view.

M. Adhesives: Use adhesives that meet the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

2.5 FABRICATION

A. Fabricate display cases to requirements indicated for dimensions, design, and thickness and finish of materials.

B. Use metals and shapes of thickness and reinforcing required to produce flat surfaces, and to impart strength for size, design, and application indicated.

C. Fabricate cabinets and door frames with reinforced corners, mitered to a hairline fit, with no exposed fasteners.

D. Fabricate shelf standards plumb and at heights to align shelf brackets for level shelves.

2.6 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM/NOMMA AMP 500 for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine walls, with Installer present, for compliance with requirements for installation tolerances, surface conditions of wall, and other conditions affecting performance of the Work.

B. Examine roughing-in for electrical power systems to verify actual locations of connections before installation of illuminated units.

C. Examine walls and partitions for proper backing for display cases.

D. Examine walls and partitions for suitable framing depth if recessed units will be installed.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Prepare recesses for display cases as required by type and size of unit.

3.3 INSTALLATION

A. General: Install units in locations and at mounting heights indicated on Drawings. Keep perimeter lines straight, level, and plumb. Provide grounds, clips, backing materials, adhesives, brackets, anchors, trim, and accessories necessary for complete installation.

B. Recessed Display Cases: Attach units to wall framing with fasteners at not more than 16 inches o.c. Attach aluminum trim over edges of recessed display cases and conceal grounds and clips. Attach trim with fasteners at not more than 24 inches o.c.

C. Surface-Mounted Display Cases: Attach units to wall surfaces with concealed clips, hangers, or grounds fastened at not more than 16 inches o.c. Secure tops and bottoms of display cases to walls.

D. Floor-Mounted Display Cases: Attach display cases with bases to floor with concealed anchors.

E. Comply with requirements specified elsewhere for connecting illuminated display cases.

F. Install display case shelving level and straight.

3.4 ADJUSTING AND CLEANING

A. Adjust doors to operate smoothly without warp or bind and so contact points meet accurately. Lubricate operating hardware as recommended in writing by manufacturer.

B. Touch up factory-applied finishes to restore damaged areas.

END OF SECTION

This page is intentionally left blank.

SECTION 10 14 00 - SIGNAGE

PART 1 - GENERAL

1.1 SUMMARY

A. Description of Work: Signage for site monument, building identification, departmental identification, general directional wayfinding, room-identification, and official seals, including informational code-required stairway and other signage.

B. Section Includes:

1. Plaques.
2. High-Density urethane plaques.
3. Dimensional letter signage.
4. Panel signage.
5. Field-applied, vinyl-character signs.

1.2 DEFINITIONS

A. Accessible: In accordance with the accessibility standard.

1.3 COORDINATION

A. Furnish templates for placement of sign-anchorage devices embedded in permanent construction by other installers.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of sign.

B. Sustainable Design Submittals:

1. Product Data: For adhesives, indicating VOC content.
2. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting materials.

C. Shop Drawings: For signage.

1. Include fabrication and installation details and attachments to other work.
2. Show signage mounting heights, locations of supplementary supports to be provided by other installers, and accessories.
3. Show message list, typestyles, graphic elements, including raised characters and Braille, and layout for each sign at least half size.

D. Samples for Verification: For each type of signage assembly showing all components and with the required finish(es), in manufacturer's standard size unless otherwise indicated and as follows:

1. Plaques: Full-size Sample.
2. Dimensional Characters: Full-size Sample of each type of dimensional character.
3. Panel Signs: Full-size Sample.
4. Field-Applied, Vinyl-Character Signs: Full-size Sample of characters on glass.
5. Exposed Accessories: Full-size Sample of each accessory type.
6. Full-size Samples, if approved, will be returned to Contractor for use in the Project.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer and manufacturer.

B. Sample Warranty: For special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For all signage types to include in maintenance manuals.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

1.8 FIELD CONDITIONS

A. Field Measurements: Verify locations of anchorage devices embedded in permanent construction by other installers by field measurements before fabrication, and indicate measurements on Shop Drawings.

1.9 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of signage that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Deterioration of finishes beyond normal weathering.
b. Deterioration of embedded graphic image.
c. Separation or delamination of sheet materials and components.

2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Accessibility Standard: Comply with applicable provisions in the USDOJ's "2010 ADA Standards for Accessible Design" and ICC A117.1.

2.2 PLAQUES

A. Cast Plaque: Cast-metal plaque with background texture, border, and characters having uniform faces, sharp corners, and precisely formed lines and profiles; and as follows:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. A.R.K. Ramos.
b. ACE Sign Systems, Inc.
c. Erie Landmark Company; a division of Paul W. Zimmerman Foundaries, Inc.
d. Gemini Signage; Gemini, Inc.
e. Matthews International Corporation; Bronze Division.
f. Metallic Arts.
g. Signs & Decal Corp.
h. Southwell Company (The).

2. Plaque Material: Cast bronze.
3. Plaque Thickness: 0.50 inch.
4. Finishes:

a. Integral Metal Finish: Satin finish raised surface with dark oxidized background.
b. Overcoat: Manufacturer's standard baked-on clear coating.

5. Background Texture: Leatherette.
6. Integrally Cast Border Style: Square single line, polished.
7. Mounting: Concealed studs.
8. Graphics, Text, and Typeface: Custom, based on artwork provided by Architect.

B. High-Density Urethane Plaques: 3-inch-thick, 30 lbf/cu. ft. density, urethane foam carved sign mounted on 1/2-inch-thick aluminum plate backing.

1. Graphics, Text, and Typeface: Custom, based on artwork provided by Architect.
2. Mounting: Concealed; delegated-design by signage contractor and suitable for substrate indicated.

a. Performance requirements: Design signage attachment to withstand the following loads:

1) Gravity load of sign.

3. Finish: As selected by Architect from manufacturer’s full range of metallic paint finishes.

2.3 DIMENSIONAL LETTER SIGNAGE

A. Cast Characters: Characters with uniform faces, sharp corners, and precisely formed lines and profiles, and as follows:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. A.R.K. Ramos.
b. ACE Sign Systems, Inc.
c. ASI Sign Systems, Inc.
d. Cosco.
e. Gemini Signage; Gemini, Inc.
f. Matthews International Corporation; Bronze Division.
g. Metal Arts.
h. Metallic Arts.
i. Southwell Company (The).

2. Character Material: Cast bronze.
3. Character Height: As indicated on Drawings.
4. Thickness: As indicated on Drawings.
5. Finishes:

a. Integral Metal Finish: [**Mill**] [**Antique oxidized**] [**As indicated by manufacturer's designation**] [**Match Architect's sample**] [**As selected by Architect from full range of industry finishes**] <**Insert finish**>.
b. Overcoat: Manufacturer's standard baked-on clear coating.

6. Mounting: As indicated on Drawings.
7. Typeface: As indicated on Drawings.

2.4 PANEL SIGNAGE

A. Panel Sign: Sign with smooth, uniform surfaces; with message and characters having uniform faces, sharp corners, and precisely formed lines and profiles; and as follows:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. APCO Graphics, Inc.
b. ASI Sign Systems, Inc.
c. inpro Corporation.

2. Solid-Sheet Sign: Aluminum sheet with finish specified in "Surface Finish and Applied Graphics" Subparagraph and as follows:

a. Thickness: 0.080 inch.
b. Surface-Applied, Flat Graphics: Applied vinyl film.
c. Surface-Applied, Raised Graphics: Applied polymer characters and Braille.

3. Sign-Panel Perimeter: Finish edges smooth.

a. Edge Condition: Square cut.

b. Corner Condition in Elevation: Square.

4. Mounting: Manufacturer's standard method for substrates indicated with.

5. Text and Typeface: Accessible raised characters and Braille typeface as selected by Architect from manufacturer's full range and variable content as scheduled. Finish raised characters to contrast with background color, and finish Braille to match background color.
6. Flatness Tolerance: Sign shall remain flat or uniformly curved under installed conditions as indicated on Drawings and within a tolerance of plus or minus 1/16 inch measured diagonally from corner to corner.

2.5 FIELD-APPLIED, VINYL-CHARACTER SIGNS

A. Field-Applied, Vinyl-Character Sign: Prespaced characters die cut from 3- to 3.5-mil thick, weather-resistant vinyl film with release liner on the back and carrier film on the front for on-site alignment and application.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. APCO Graphics, Inc.
b. Allen Markings.
c. Mohawk Sign Systems.
d. Seton Identification Products; a Brady Corporation company.
e. inpro Corporation.

2. Size: As indicated on Drawings.
3. Substrate: As indicated on Drawings.
4. Text and Font: As indicated on Drawings.

2.6 PLAQUE MATERIALS

A. Bronze Castings: ASTM B584, alloy recommended by manufacturer and finisher for finish indicated.

2.7 DIMENSIONAL LETTER MATERIALS

A. Bronze Castings: ASTM B584, alloy recommended by manufacturer and finisher for finish indicated.

2.8 PANEL-SIGN MATERIALS

A. Aluminum Sheet and Plate: ASTM B209, alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.

B. Vinyl Film: UV-resistant vinyl film of nominal thickness indicated, with pressure-sensitive, permanent adhesive on back; die cut to form characters or images as indicated on Drawings and suitable for exterior applications.

C. Paints and Coatings for Sheet Materials: Inks, dyes, and paints that are recommended by manufacturer for optimum adherence to surface and are UV and water resistant for colors and exposure indicated.

2.9 ACCESSORIES

A. Fasteners and Anchors: Manufacturer's standard as required for secure anchorage of signs, noncorrosive and compatible with each material joined, and complying with the following:

1. Use concealed fasteners and anchors unless indicated to be exposed.
2. For exterior exposure, furnish stainless steel devices unless otherwise indicated.

3. Sign Mounting Fasteners:

a. Concealed Studs: Concealed (blind), threaded studs welded or brazed to back of sign material, screwed into back of sign assembly, or screwed into tapped lugs cast integrally into back of cast sign material, unless otherwise indicated.
b. Projecting Studs: Threaded studs with sleeve spacer, welded or brazed to back of sign material, screwed into back of sign assembly, or screwed into tapped lugs cast integrally into back of cast sign material, unless otherwise indicated.

B. Adhesive: As recommended by sign manufacturer.

1. Verify adhesives have a VOC content of 70 g/L or less.
2. Verify adhesive complies with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

C. Two-Face Tape: Manufacturer's standard high-bond, foam-core tape, 0.045 inch thick, with adhesive on both sides.

D. Hook-and-Loop Tape: Manufacturer's standard two-part tape consisting of hooked part on sign back and looped side on mounting surface.

2.10 GENERAL FINISH REQUIREMENTS

A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.11 ALUMINUM FINISHES

A. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of 1.5 mils. Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

2.12 LACQUER COATING FOR COPPER-ALLOY FINISHES

A. Lacquer Coating: Clear, organic, waterborne, air-drying, acrylic lacquer called "Incralac"; specially developed for coating copper-alloy products; consisting of a solution of acrylic resin, methyl methacrylate copolymer, leveling agent, and corrosion inhibitor benzotriazole.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Verify that support surfaces are within tolerances to accommodate plaques without gaps or irregularities between backs of plaques and support surfaces unless otherwise indicated.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION GENERAL

A. General: Install signs using mounting methods indicated and according to manufacturer's written instructions.

1. Install signs level, plumb, true to line, and at locations and heights indicated, with sign surfaces free of distortion and other defects in appearance.
2. Before installation, verify that sign surfaces are clean and free of materials or debris that would impair installation.
3. Corrosion Protection: Coat concealed surfaces of exterior aluminum in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.

3.3 INSTALLATION OF METAL PLAQUES

A. Mounting Methods:

1. Concealed Studs: Using a template, drill holes in substrate aligning with studs on back of plaque. Remove loose debris from hole and substrate surface.

a. Thin or Hollow Surfaces: Place plaque in position and flush to surface, install washers and nuts on studs projecting through opposite side of surface, and tighten.

3.4 INSTALLATION OF DIMENSIONAL CHARACTERS

A. Mounting Methods:

1. Concealed Studs: Using a template, drill holes in substrate aligning with studs on back of sign. Remove loose debris from hole and substrate surface.

    a. Masonry Substrates: Fill holes with adhesive. Leave recess space in hole for displaced adhesive. Place sign in position and push until flush to surface, embedding studs in holes. Temporarily support sign in position until adhesive fully sets.
    b. Thin or Hollow Surfaces: Place sign in position and flush to surface, install washers and nuts on studs projecting through opposite side of surface, and tighten.

2. Projecting Studs: Using a template, drill holes in substrate aligning with studs on back of sign. Remove loose debris from hole and substrate surface.

    a. Masonry Substrates: Fill holes with adhesive. Leave recess space in hole for displaced adhesive. Place spacers on studs, place sign in position, and push until spacers are pinched between sign and substrate, embedding the stud ends in holes. Temporarily support sign in position until adhesive fully sets.
    b. Thin or Hollow Surfaces: Place spacers on studs, place sign in position with spacers pinched between sign and substrate, and install washers and nuts on stud ends projecting through opposite side of surface, and tighten.

3.5 INSTALLATION OF PANEL SIGNS

A. Accessible Signage: Install in locations on walls as indicated on Drawings and according to the accessibility standard.

B. Mounting Methods:

1. Adhesive: Clean bond-breaking materials from substrate surface and remove loose debris. Apply linear beads or spots of adhesive symmetrically to back of sign and of suitable quantity to support weight of sign after cure without slippage. Keep adhesive away from edges to prevent adhesive extrusion as sign is applied and to prevent visibility of cured adhesive at sign edges. Place sign in position, and push to engage adhesive. Temporarily support sign in position until adhesive fully sets.
2. Two-Face Tape: Clean bond-breaking materials from substrate surface and remove loose debris. Apply tape strips symmetrically to back of sign and of suitable quantity to support weight of sign without slippage. Keep strips away from edges to prevent visibility at sign edges. Place sign in position, and push to engage tape adhesive.
3. Hook-and-Loop Tape: Clean bond-breaking materials from substrate surface and remove loose debris. Apply sign component of two-part tape strips symmetrically to back of sign and of suitable quantity to support weight of sign without slippage; push to engage tape adhesive. Keep tape strips 0.250 inch away from edges to prevent visibility at sign edges when sign is initially installed or reinstalled. Apply substrate component of tape to substrate in locations aligning with tape on back of sign; push and rub well to fully engage tape adhesive to substrate.

C. Field-Applied, Vinyl-Character Signs: Clean and dry substrate. Align sign characters in final position before removing release liner. Remove release liner in stages, and apply and firmly

press characters into final position. Press from the middle outward to obtain good bond without blisters or fishmouths. Remove carrier film without disturbing applied vinyl film.

3.6 ADJUSTING AND CLEANING

A. Remove and replace damaged or deformed characters, plaques and signs that do not comply with specified requirements. Replace characters, plaques, and signs with damaged or deteriorated finishes or components that cannot be successfully repaired by finish touchup or similar minor repair procedures.

B. Remove temporary protective coverings and strippable films as signs are installed.

C. On completion of installation, clean exposed surfaces of signs according to manufacturer's written instructions, and touch up minor nicks and abrasions in finish. Maintain plaques in a clean condition during construction and protect from damage until acceptance by Owner.

END OF SECTION

This page is intentionally left blank.

SECTION 10 21 13.17 - PHENOLIC-CORE TOILET COMPARTMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Phenolic-core toilet compartments.

B. Related Requirements:

1. Section 055000 "Metal Fabrications" for supports that attach ceiling-hung compartments to overhead structural system.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for toilet compartments.

B. Shop Drawings: For toilet compartments.

1. Include plans, elevations, sections, details, and attachment details.
2. Show locations of cutouts for compartment-mounted toilet accessories.
3. Show locations of centerlines of toilet fixtures.
4. Show locations of floor drains.
5. Show ceiling grid, ceiling-mounted items, and overhead support or bracing locations.

C. Samples for Verification: For the following products, in manufacturer's standard sizes unless otherwise indicated:

1. Each type of material, color, and finish required for toilet compartments, prepared on 6-inch-square Samples of same thickness and material indicated for Work.
2. Each type of hardware and accessory.

D. Delegated Design Submittals: For grab bars mounted on toilet compartment panels, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Include structural design calculations indicating compliance with specified structural-performance requirements.

E. Sustainable Design Submittals:

1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.
2. Low-Emitting Materials: Provide testing reports in accordance with the General Emissions Evaluation.

3. Laboratory Test Reports: For product, indicating compliance with requirements for low-emitting materials.

1.3 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of toilet compartment.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For toilet compartments to include in maintenance manuals.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Door Hinges: One hinge(s) with associated fasteners.
2. Latch and Keeper: One latch(es) and keeper(s) with associated fasteners.
3. Door Bumper: One door bumper(s) with associated fasteners.
4. Door Pull: One door pull(s) with associated fasteners.
5. Fasteners: Ten fasteners of each size and type.

1.6 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of toilet fixtures, walls, columns, ceilings, and other construction contiguous with toilet compartments by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Recycled Content: Provide products with postconsumer recycled content plus one-half of preconsumer recycled content to the extent required to comply with the minimum criteria specified in Section 01 81 13.14 “Sustainable Design Requirements.”

B. Regional Materials: To the extent required to comply with the minimum criteria specified in Section 01 81 13.14 “Sustainable Design Requirements,” manufacture products within 100 miles of Project site from materials that have been extracted, harvested, or recovered, as well as manufactured, within 100 miles of Project site.

C. Product shall be made without urea formaldehyde.

D. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: 75 or less.

2. Smoke-Developed Index: 450 or less.

E. Regulatory Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines for Buildings and Facilities and ICC A117.1 for toilet compartments designated as accessible.

2.2 PHENOLIC-CORE TOILET COMPARMENTS

A. Basis-of-Design Product: Subject to compliance with requirements, provide **ASI Global Partitions; Ultimate Privacy 72** or a comparable product by one of the following:

1. Bobrick Washroom Equipment, Inc.
2. Bradley Corporation.
3. General Partitions Mfg. Corp.
4. Metpar Corp.

B. Toilet-Enclosure Style: Ceiling hung.

C. Urinal-Screen Style: Wall hung.

D. Door, Panel, and Pilaster Construction: Solid phenolic-core panel material with melamine facing on both sides fused to substrate during panel manufacture (not separately laminated), and with eased and polished edges and no-sightline system. Provide minimum 3/4-inch-thick doors and pilasters and minimum 1/2-inch-thick panels.

E. Pilaster Shoes and Sleeves (Caps): Formed from stainless steel sheet, not less than 0.031-inch nominal thickness and 3 inches high, finished to match hardware.

F. Brackets (Fittings):

1. Full-Height (Continuous) Type: Manufacturer's standard design; stainless steel.

G. Phenolic-Panel Finish:

1. Facing Sheet Finish: One color and pattern in each room.
2. Color and Pattern: As preselected and indicated in Finish Schedule with manufacturer's standard dark color core.

2.3 HARDWARE AND ACCESSORIES

A. Hardware and Accessories: Manufacturer's heavy-duty operating hardware and accessories.

1. Hinges: Manufacturer's minimum 0.062-inch-thick stainless steel paired, self-closing type that can be adjusted to hold doors open at any angle up to 90 degrees, allowing emergency access by lifting door. Mount with through-bolts.
2. Indicator Latch and Keeper: Manufacturer's heavy-duty surface-mounted cast-stainless steel latch unit designed to resist damage due to slamming, with combination rubber-faced door strike and keeper, and with provision for emergency access. Provide units that comply with regulatory requirements for accessibility at compartments designated as accessible. Mount with through-bolts. Latch to indicate if stall is occupied and provided with antimicrobial finish.

3. Coat Hook: Manufacturer's heavy-duty combination cast-stainless steel hook and rubber-tipped bumper, sized to prevent in-swinging door from hitting compartment-mounted accessories. Mount with through-bolts.
4. Door Pull: Manufacturer's heavy-duty cast-stainless steel pull at out-swinging doors that complies with regulatory requirements for accessibility. Provide units on both sides of doors at compartments designated as accessible. Mount with through-bolts.

B. Anchorages and Fasteners: Manufacturer's standard exposed fasteners of stainless steel, finished to match the items they are securing, with theft-resistant-type heads. Provide sex-type bolts for through-bolt applications. For concealed anchors, use stainless steel, hot-dip galvanized-steel, or other rust-resistant, protective-coated steel compatible with related materials.

2.4 MATERIALS

A. Stainless Steel Sheet: ASTM A240/A240M or ASTM A666, Type 304, stretcher-leveled standard of flatness.

B. Stainless Steel Castings: ASTM A743/A743M.

2.5 FABRICATION

A. Fabrication, General: Fabricate toilet compartment components to sizes indicated. Coordinate requirements and provide cutouts for through-partition toilet accessories where required for attachment of toilet accessories.

B. Ceiling-Hung Units: Provide manufacturer's standard corrosion-resistant anchoring assemblies with leveling adjustment nuts at pilasters for connection to structural support above finished ceiling. Provide assemblies that support pilasters from structure without transmitting load to finished ceiling. Provide sleeves (caps) at tops of pilasters to conceal anchorage.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for fastening, support, alignment, operating clearances, and other conditions affecting performance of the Work.

1. Confirm location and adequacy of blocking and supports required for installation.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Comply with manufacturer's written installation instructions. Install units rigid, straight, level, and plumb. Secure units in position with manufacturer's recommended anchoring devices.

1. Maximum Clearances:

    a. Pilasters and Panels: 1/2 inch.
    b. Panels and Walls: 1 inch.

2. Full-Height (Continuous) Brackets: Secure panels to walls and to pilasters with full-height brackets.

    a. Locate bracket fasteners so holes for wall anchors occur in masonry or tile joints.
    b. Align brackets at pilasters with brackets at walls.

B. Ceiling-Hung Units: Secure pilasters to supporting structure and level, plumb, and tighten. Hang doors and adjust so bottoms of doors are level with bottoms of pilasters when doors are in closed position.

C. Urinal Screens: Attach with anchoring devices to suit supporting structure. Set units level and plumb, rigid, and secured to resist lateral impact.

3.3 ADJUSTING

A. Hardware Adjustment: Adjust and lubricate hardware according to hardware manufacturer's written instructions for proper operation. Set hinges on in-swinging doors to hold doors open approximately 30 degrees from closed position when unlatched. Set hinges on out-swinging doors to return doors to fully closed position.

END OF SECTION

This page is intentionally left blank.

SECTION 10 22 13 - WIRE MESH PARTITIONS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Standard-duty wire mesh partitions.

1.2 DEFINITIONS

A. Intermediate Crimp: Wires pass over one and under the next adjacent wire in both directions, with wires crimped before weaving and with extra crimps between the intersections.

B. Lock Crimp: Deep crimps at points of the intersection that lock wires securely in place.

1.3 ACTION SUBMITTALS

A. Product Data:

1. Wire mesh partitions.

2. Include plans, elevations, sections, and attachment details.
3. Indicate clearances required for operation of doors.

B. Samples for Verification: Panel constructed of specified frame members and wire mesh. Show method of finishing members at intersections.

1. Size: 12 by 12 inches.

C. Delegated Design Submittals: For wire mesh partitions indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

D. Sustainable Design Submittals:

1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.

1.4 INFORMATIONAL SUBMITTALS

A. Certificates:

1. Welding certificates.

B. Qualification Statements: For Installer.

C. Delegated design engineer qualifications.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For wire mesh partition hardware.

1.6 QUALITY ASSURANCE

A. Qualifications:

1. Installers: Authorized representative who is trained and approved by manufacturer.
2. Welding Qualifications: Qualify procedures and personnel in accordance with the following welding codes:

a. AWS D1.1/D1.1M.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver wire mesh items with cardboard protectors on perimeters of panels and doors and with posts wrapped to provide protection during transit and Project-site storage. Use vented plastic.

B. Inventory wire mesh partition door hardware on receipt, and provide secure lockup for wire mesh partition door hardware delivered to Project site.

1. Tag each item or package separately with identification, and include basic installation instructions with each item or package.

1.8 FIELD CONDITIONS

A. Field Measurements: Verify actual dimensions of construction contiguous with wire mesh units by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Acorn Wire & Iron Works.
2. American Wire Corporation.
3. California Wire Products Corporation.
4. G-S Company (The).
5. Indiana Wire Products, Inc.

6. Kenco Wire & Iron Products Inc.
7. King Wire Partitions, Inc.
8. Standard Wire & Steel Works.
9. WIPCO; a division of Jesco Industries, Inc.
10. WireCrafters, LLC.

2.2 SOURCE LIMITATIONS

A. For wire mesh products, obtain each color, grade, finish, type, and variety from single source with resources to provide products of consistent quality in appearance and physical properties.

2.3 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design wire mesh units.

B. Structural Performance: Wire mesh units to withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated.

1. Concentrated load of 50 lbf applied horizontally on an area of 1 sq. ft. at any location on a panel.
2. Total load of 200 lbf applied uniformly over each panel.
3. Concentrated load and total load need not be assumed to act concurrently.

C. Regulatory Requirements: Comply with applicable provisions in the United States Access Board's ADA-ABA Accessibility Guidelines and ICC A117.1 for doors and gates designated as accessible.

2.4 STANDARD-DUTY WIRE MESH PARTITIONS

A. Mesh: 0.135-inch-diameter, intermediate-crimp steel wire woven into 1-1/2-inch diamond mesh.

B. Vertical Panel Framing: 1-1/4-by-5/8-by-0.080-inch cold-rolled, C-shaped steel channels with holes for 1/4-inch-diameter bolts not more than 12 inches o.c.

C. Horizontal Panel Framing: 1-by-1/2-by-1/8-inch cold-rolled steel channels.

D. Horizontal Panel Stiffeners: Two cold-rolled steel channels, 3/4 by 3/8 by 1/8 inch, bolted or riveted toe to toe through mesh; or one 1-by-1/2-by-1/8-inch cold-rolled steel channel with wire mesh woven through channel.

E. Top Capping Bars: 2-1/4-by-1-inch cold-rolled steel channels.

F. Posts for 90-Degree Corners: 1-1/4-by-1-1/4-by-1/8-inch steel angles or square tubes with holes for 1/4-inch-diameter bolts aligning with bolt holes in vertical framing; with floor anchor clips.

G. Posts for Other-Than-90-Degree Corners: Steel pipe or tubing with holes for 1/4-inch-diameter bolts aligning with bolt holes in vertical framing; with floor anchor clips.

1. Partitions up to 12 Ft. High: 1-1/4-inch OD by 1/8 inch.
2. Partitions up to 20 Ft. High: 2-1/2-inch OD by 1/8 inch.

H. Adjustable Corner Posts: Two 1-1/4-by-5/8-by-0.080-inch cold-rolled, C-shaped steel channels connected by steel hinges at 36 inches o.c., with holes for 1/4-inch-diameter bolts aligning with bolt holes in vertical framing.

I. Line Posts: 3-inch-by-4.1-lb or 3-1/2-by-1-1/4-by-0.127-inch steel channels; with 1/4-inch steel base plates.

J. Three-Way Intersection Posts: 1-1/4-by-1-1/4-by-1/8-inch steel tubes or channels, with holes for 1/4-inch-diameter bolts aligned for bolting to adjacent panels.

K. Four-Way Intersection Posts: 1-1/4-by-1-1/4-by-1/8-inch steel tubes, with holes for 1/4-inch-diameter bolts aligned for bolting to adjacent panels.

L. Floor Shoes: Metal, not less than 2 inches high; sized to suit vertical framing, drilled for attachment to floor, and with setscrews for leveling adjustment.

M. Swinging Doors: Fabricated from same mesh as partitions, with framing fabricated from 1-1/4-by-1/2-by-1/8-inch steel channels or 1-1/4-by-5/8-by-0.080-inch cold-rolled, C-shaped steel channels, banded with 1-1/4-by-1/8-inch flat steel bar cover plates on four sides, and with 1/8-inch-thick angle strike bar and cover on strike jamb.

1. Hinges: Full-surface type, 3-by-3-inch steel, three per door; bolted, riveted, or welded to door and jamb framing.
2. Cylinder Lock: Mortise type with cylinder specified in Section 08 71 00 "Door Hardware"; operated by key outside and recessed turn knob inside.
3. Inactive Leaf Hardware: Cane bolt at bottom and chain bolt at top.

N. Accessories:

1. Adjustable Filler Panels: 0.060-inch-thick, steel sheet; capable of filling openings from 2 to 12 inches.
2. Wall Clips: Manufacturer's standard, steel sheet; allowing up to 1 inch of adjustment.

O. Finish: Hot-dip galvanized unless otherwise indicated.

2.5 MATERIALS

A. Recycled Content of Steel Products: Provide products with postconsumer recycled content plus one-half of preconsumer recycled content to the extent required to comply with the minimum criteria specified in Section 01 81 13.14 “Sustainable Design Requirements.”

B. Steel Wire: ASTM A510/A510M.

C. Steel Plates, Channels, Angles, and Bars: ASTM A36/A36M.

D. Steel Sheet: Cold-rolled steel sheet, ASTM A1008/A1008M, Commercial Steel (CS), Type B.

E. Steel Tubing: ASTM A500/A500M, cold-formed structural-steel tubing or ASTM A513/A513M, Type 5, mandrel-drawn mechanical tubing.

F. Panel-to-Panel Fasteners: Manufacturer's standard steel bolts, nuts, and washers.

G. Galvanizing Repair Paint: High-zinc-dust-content paint for regalvanizing welds in steel, complying with SSPC-Paint 20.

2.6 FABRICATION

A. General: Fabricate wire mesh items from components of sizes not less than those indicated. Use larger-sized components as recommended by wire mesh item manufacturer. Furnish bolts, hardware, and accessories required for complete installation with manufacturer's standard finishes.

1. Fabricate wire mesh items to be readily disassembled.
2. Welding: Weld corner joints of framing and finish sand.

B. Standard-Duty Wire Mesh Partitions: Fabricate wire mesh partitions with cutouts for pipes, ducts, beams, and other items indicated. Finish edges of cutouts to provide a neat, protective edge.

1. Mesh: Securely clinch mesh to framing.
2. Framing: Fabricate framing with mortise-and-tenon corner construction.

    a. Provide horizontal stiffeners as indicated or, if not indicated, as required by panel height and as recommended by wire mesh partition manufacturer. Weld horizontal stiffeners to vertical framing.
    b. Fabricate partition and door framing with slotted holes for connecting adjacent panels.

3. Fabricate wire mesh partitions with 3 to 4 inches of clear space between finished floor and bottom horizontal framing.
4. Doors: Align bottom of door with bottom of adjacent panels.

    a. For doors that do not extend full height of partition, provide transom over door, fabricated from same mesh and framing as partition panels.

5. Hardware Preparation: Mortise, reinforce, drill, and tap doors and framing as required to install hardware.

2.7 STEEL AND IRON FINISHES

A. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A153/A153M for steel and iron hardware and with ASTM A123/A123M for other steel and iron products.

1. Do not quench or apply post-galvanizing treatments that might interfere with paint adhesion.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine floors for suitable conditions where wire mesh items will be installed.

C. Examine walls to which wire mesh items will be attached for properly located blocking, grounds, and other solid backing for attachment of support fasteners.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF WIRE MESH PARTITIONS

A. Anchor wire mesh partitions to floor with 3/8-inch-diameter, postinstalled expansion anchors at 12 inches o.c. through floor shoes located at each post and corner. Adjust wire mesh partition posts in floor shoes to achieve level and plumb installation.

1. Anchors may be set with power-actuated fasteners instead of postinstalled expansion anchors if indicated on Shop Drawings.

B. Anchor wire mesh partitions to walls at 12 inches o.c. through back corner panel framing and as follows:

1. For concrete and solid masonry anchorage, use expansion anchors.
2. For hollow masonry anchorage, use toggle bolts.

C. Secure top capping bars to top framing channels with 1/4-inch-diameter, "U" bolts spaced not more than 28 inches o.c.

D. Provide line posts at locations indicated or, if not indicated, as follows:

1. For partitions that are 7 to 9 ft. high, spaced at 15 to 20 ft. o.c.
2. For partitions that are 10 to 12 ft. high, located between every other panel.
3. For partitions that are more than 12 ft. high, located between each panel.

E. Where standard-width wire mesh partition panels do not fill entire length of run, provide adjustable filler panels to fill openings.

F. Install doors complete with door hardware.

G. Bolt accessories to wire mesh partition framing.

3.3 REPAIR

A. Repair of Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A780/A780M.

3.4 ADJUSTING

A. Adjust doors to operate smoothly and easily, without binding or warping. Adjust hardware to function smoothly. Verify that latches and locks engage accurately and securely without forcing or binding.

3.5 PROTECTION

A. Remove and replace defective work, including doors and framing that are warped, bowed, or otherwise unacceptable.

END OF SECTION

This page is intentionally left blank.

SECTION 10 22 39 - FOLDING PANEL PARTITIONS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Electrically operated, acoustical panel partitions.

B. Related Requirements:

1. Section 055000 "Metal Fabrications" for supports that attach supporting tracks to overhead structural system.
2. Section 092900 "Gypsum Board" for fire-rated assemblies and sound barrier construction above the ceiling at track.
3. Electrical and communications Sections for electrical service and connections for motor operators, controls, and limit switches and for system disconnect switches.

1.2 DEFINITIONS

A. NIC: Noise Isolation Class.

B. NRC: Noise Reduction Coefficient.

C. STC: Sound Transmission Class.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:

1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.

C. Shop Drawings: For operable panel partitions.

1. Include plans, elevations, sections, attachment details.
2. Indicate stacking and operating clearances. Indicate location and installation requirements for hardware and track, blocking, and direction of travel.
3. Include diagrams for power, signal, and control wiring.

D. Samples for Verification: For each type of exposed material, finish, covering, or facing, prepared on Samples of size indicated below:

1. Textile Facing Material: Full width by not less than 36-inch-long section of fabric from dye lot to be used for the Work, with specified treatments applied. Show complete pattern repeat.
2. Panel Edge Material: Not less than 3 inches long.
3. Hardware: One of each exposed door-operating device.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Partition track, track supports and bracing, switches, turning space, and storage layout.
2. Suspended ceiling components.
3. Structural members to which suspension systems will be attached.
4. Size and location of initial access modules for acoustical tile.
5. Plenum acoustical barriers.

B. Setting Drawings: For embedded items and cutouts required in other work, including support-beam, mounting-hole template.

C. Qualification Data: For Installer.

D. Product Certificates: For each type of operable panel partition.

E. Product Test Reports: For each operable panel partition, for tests performed by a qualified testing agency.

F. Sample Warranty: For manufacturer's special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For operable panel partitions to include in maintenance manuals.

1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

a. Panel finish facings and finishes for exposed trim and accessories. Include precautions for cleaning materials and methods that could be detrimental to finishes and performance.
b. Seals, hardware, track, track switches, carriers, and other operating components.
c. Electric operator and controls.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same production run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Panel Finish-Facing Material: Furnish full width in quantity to cover both sides of two panels when installed.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Protectively package and sequence panels in order for installation. Clearly mark packages and panels with numbering system used on Shop Drawings. Do not use permanent markings on panels.

1.9 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of operable panel partitions that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Faulty operation of operable panel partitions.
b. Deterioration of metals, metal finishes, and other materials beyond normal use.

2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Acoustical Performance: Provide operable panel partitions tested by a qualified testing agency for the following acoustical properties according to test methods indicated:

1. Sound-Transmission Requirements: Operable panel partition assembly tested for laboratory sound-transmission loss performance according to ASTM E90, determined by ASTM E413, and rated for not less than the STC indicated.

B. Fire-Test-Response Characteristics: Provide panels with finishes complying with one of the following as determined by testing identical products by a testing and inspecting agency acceptable to authorities having jurisdiction:

1. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

a. Flame-Spread Index: 25 or less.
b. Smoke-Developed Index: 450 or less.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.2 OPERABLE ACOUSTICAL PANELS

A. Operable Acoustical Panels: Partition system, including panels, seals, finish facing, suspension system, operators, and accessories.

1. Basis-of-Design Product: Subject to compliance with requirements, provide **Hufcor, Inc.; Model #643E** or a comparable product by one of the following:

a. Advanced Equipment Corporation.
b. Modernfold, Inc.

B. Panel Operation: Electrically operated, continuously hinged panels.

C. Panel Construction: As required to support panel from suspension components and with reinforcement for hardware attachment. Fabricate panels with tight hairline joints and concealed fasteners. Fabricate panels so finished in-place partition is rigid; level; plumb; aligned, with tight joints and uniform appearance; and free of bow, warp, twist, deformation, and surface and finish irregularities.

1. Impact Zone Construction: Construct panel with a horizontal splice matching vertical panel-to-panel joints with no trim and located at 10 feet above finished floor to permit easy repair of panel surfaces damaged in the impact zone. Horizontal trim is not acceptable.

D. Dimensions: Fabricate operable acoustical panel partitions to form an assembled system of dimensions indicated and verified by field measurements.

1. Panel Width: As indicated.

E. STC: Not less than 54.

F. Panel Weight: 7.8 to 10.9 lb/sq. ft. maximum.

G. Panel Thickness: Nominal dimension of 4 inches.

H. Panel Materials:

1. Recycled Content: Provide products with postconsumer recycled content plus one-half of preconsumer recycled content to the extent required to comply with the minimum criteria specified in Section 01 81 13.14 “Sustainable Design Requirements.”
2. Adhesives: Use adhesives that meet the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
3. Steel Frame: Steel sheet, 0.56-inch (16-gage) nominal minimum thickness for uncoated steel.
4. Steel Face/Liner Sheets: Tension-leveled steel sheet, 0.0359-inch (21-gage) minimum nominal thickness for uncoated steel.

I. Panel Closure: Manufacturer's standard unless otherwise indicated.

J. Hardware: Manufacturer's standard as required to operate operable panel partition and accessories; with decorative, protective finish.

1. Hinges: Manufacturer's standard.

K. Finish Facing: Fabric wall covering.

2.3 SEALS

A. Description: Seals that produce operable panel partitions complying with performance requirements and the following:

1. Manufacturer's standard seals unless otherwise indicated.
2. Seals made from materials and in profiles that minimize sound leakage.
3. Seals fitting tight at contact surfaces and sealing continuously between adjacent panels and between operable panel partition perimeter and adjacent surfaces, when operable panel partition is extended and closed.

B. Vertical Seals: Deep-nesting, interlocking astragals mounted on each edge of panel, with continuous, resilient acoustical seal.

C. Horizontal Top Seals: Continuous-contact, resilient seal exerting uniform constant pressure on track.

D. Horizontal Bottom Seals:

1. Manufacturer's standard continuous-contact seal exerting uniform constant pressure on floor.

2.4 PANEL FINISH FACINGS

A. Description: Finish facings for panels that comply with indicated fire-test-response characteristics and that are factory applied to operable panel partitions with appropriate backing, using mildew-resistant nonstaining adhesive as recommended by facing manufacturer's written instructions.

1. Apply facings free of air bubbles, wrinkles, blisters, and other defects, with edges tightly butted, and with invisible seams complying with Shop Drawings for location, and with no gaps or overlaps. Horizontal seams are not permitted. Tightly secure and conceal raw and selvage edges of facing for finished appearance.
2. Where facings with directional or repeating patterns or directional weave are indicated, mark facing top and attach facing in same direction.
3. Match facing pattern 72 inches above finished floor.

B. Fabric Wall Covering: Manufacturer's standard fabric, from same dye lot, treated to resist stains.

1. Basis-of-Design Product: Subject to compliance with requirement, provide **Hufcor; Acoustical Harmony** or comparable product.
2. Color/Pattern: As preselected and indicated in Finish Schedule.

C. Trimless Edges: Fabricate exposed panel edges so finish facing wraps uninterrupted around panel, covering edge and resulting in an installed partition with facing visible on vertical panel edges, without trim, for minimal sightlines at panel-to-panel joints.

2.5 SUSPENSION SYSTEMS

A. Tracks: Steel with adjustable steel hanger rods for overhead support, designed for operation, size, and weight of operable panel partition indicated. Aluminum track is not acceptable. Size track to support partition operation and storage without damage to suspension system, operable panel partitions, or adjacent construction. Limit track deflection to no more than 0.10 inch between bracket supports. Provide a continuous system of track sections and accessories to accommodate configuration and layout indicated for partition operation and storage.

1. Head Closure Trim: As required for acoustical performance; factory anodized.
2. Deflection Collar Assembly: Where applicable, provide manufacturer’s track support assembly designed to permit track to cross building seismic joint.

B. Carriers: Trolley system as required for configuration type, size, and weight of partition and for easy operation; with ball-bearing wheels.

C. Steel Finish: Manufacturer's standard, factory-applied, corrosion-resistant, protective coating unless otherwise indicated.

2.6 ELECTRIC OPERATORS

A. Factory-assembled electric operation system of size and capacity recommended and provided by operable panel partition manufacturer for partition specified; with electric motor and factory-prewired motor controls, speed reducer, chain drive, control stations, control devices, and accessories required for operation. Include wiring from control stations to motor. Coordinate operator wiring requirements and electrical characteristics with building electrical system.

B. Comply with NFPA 70.

C. Control Equipment: Comply with NEMA ICS 1, NEMA ICS 2, and NEMA ICS 6.

D. Motor Electrical Characteristics:

1. Horsepower: Manufacturer's standard.
2. Volts: 208.
3. Phase: Single phase.
4. Hertz: 60.

E. Control Stations: Two single-key-operated, constant-pressure control stations located remotely from each other on opposite sides and opposite ends of partition run. Wire in series to require simultaneous activation of both key stations to operate partition. Each three-position control station labeled "Open," "Close," and " Stop." Furnish two keys per station.

F. Obstruction-Detection Devices: Equip each motorized operable panel partition with indicated automatic safety sensor that causes operator to immediately shut off motor.

1. Sensor Edge: Contact-pressure-sensitive safety edge along partition's leading edge.

G. Limit Switches: Adjustable switches, interlocked with motor controls and set to automatically stop operable panel partition at fully extended and fully stacked positions.

H. Emergency Release Mechanism: Quick disconnect-release of electric-motor drive system, permitting manual operation in event of operating failure.

I. Electric Interlock: Equip each motorized operable panel partition with electric interlocks at locations indicated, to prevent operation of operable panel partition under the following conditions:

1. On storage pocket door, to prevent operation if door is not in fully open position.

2.7 ACCESSORIES

A. Pass Doors: Swinging door built into and matching panel materials, construction, acoustical qualities, finish and thickness, complete with frames and operating hardware. Hinges finished to match other exposed hardware.

1. Accessibility Standard: Fabricate doors to comply with applicable provisions in the USDOJ's "2010 ADA Standards for Accessible Design" and ICC A117.1.
2. Single Pass Door: 36 by 84 inches.
3. Pass-Door Hardware: Equip pass door with the following:

a. Door Seals: Sweep floor seals.
b. Panic hardware.
c. Concealed door closer.
d. Door Viewer: Installed with view in direction of swing.
e. Exit Sign: Recessed, self-illuminated.

B. Storage Pocket Door: Full height at end of partition runs to conceal stacked partition; of same materials, finish, construction, thickness, and acoustical qualities as panels; complete with operating hardware and acoustical seals at soffit, floor, and jambs. Hinges in finish to match other exposed hardware.

1. Manufacturer's standard method to secure storage pocket door in closed position.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine flooring, floor levelness, structural support, and opening, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of operable panel partitions.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install operable panel partitions and accessories after other finishing operations, including painting, have been completed in area of partition installation.

B. Install panels in numbered sequence indicated on Shop Drawings.

C. Broken, cracked, chipped, deformed, or unmatched panels are not acceptable.

D. Broken, cracked, deformed, or unmatched gasketing or gasketing with gaps at butted ends is not acceptable.

E. Light-Leakage Test: Illuminate one side of partition installation and observe vertical joints and top and bottom seals for voids. Adjust partitions for alignment and full closure of vertical joints and full closure along top and bottom seals.

3.3 ADJUSTING

A. Adjust operable panel partitions, hardware, and other moving parts to function smoothly, and lubricate as recommended by manufacturer.

B. Adjust pass doors and storage pocket doors to operate smoothly and easily, without binding or warping.

C. Verify that safety devices are properly functioning.

3.4 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain operable panel partitions.

END OF SECTION

SECTION 10 26 00 - WALL AND DOOR PROTECTION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Corner guards.
2. Abuse-resistant wall coverings.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, impact strength, dimensions of individual components and profiles, and finishes.

B. Sustainable Design Submittals:

1. Product Data: For adhesives, indicating VOC content.
2. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting materials.

C. Shop Drawings: For each type of wall and door protection showing locations and extent.

1. Include plans, elevations, sections, and attachment details.

D. Samples for Verification: For each type of exposed finish on the following products, prepared on Samples of size indicated below:

1. Corner Guards: 12 inches long.
2. Abuse-Resistant Wall Covering: 6 by 6 inches square.

1.3 INFORMATIONAL SUBMITTALS

A. Sample Warranty: For special warranty.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For each type of wall protection product to include in maintenance manuals.

1. Include recommended methods and frequency of maintenance for maintaining best condition of plastic covers under anticipated traffic and use conditions. Include precautions against using cleaning materials and methods that may be detrimental to finishes and performance.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store wall and door protection in original undamaged packages and containers inside well-ventilated area protected from weather, moisture, soiling, extreme temperatures, and humidity.

1. Maintain room temperature within storage area at not less than 70 deg F during the period plastic materials are stored.
2. Keep plastic materials out of direct sunlight.
3. Store plastic wall- and door-protection components for a minimum of 72 hours, or until plastic material attains a minimum room temperature of 70 deg F.

a. Store corner-guard covers in a vertical position.
b. Store wall-guard covers in a horizontal position.

1.6 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of wall- and door-protection units that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures including detachment of components from each other or from the substrates, delamination, and permanent deformation beyond normal use.
b. Deterioration of metals, metal finishes, plastics, and other materials beyond normal use.

2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain wall- and door-protection products of each type from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Surface Burning Characteristics: Comply with ASTM E84 or UL 723; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: 25 or less.
2. Smoke-Developed Index: 450 or less.

B. Regulatory Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines for Buildings and Facilities and ICC A117.1 Insert requirement.

2.3 CORNER GUARDS

A. Surface-Mounted, Metal Corner Guards: Fabricated as one piece from formed or extruded metal with formed edges and returns to match depth of adjacent gypsum board; with 90- or 135-degree turn to match wall condition.

1. Basis-of-Design Product: Subject to compliance with requirements, provide **Construction Specialties, Inc.; Acrovyn 8PH-Series** or a comparable product by one of the following:

    a. Babcock-Davis.
    b. Balco; a CSW Industrials Company.
    c. J. L. Industries, Inc.; Activar Construction Products Group, Inc.
    d. Koroseal Interior Products, LLC.
    e. Nystrom, Inc.

2. Material: Stainless-steel sheet, Type 304.

    a. Thickness: Minimum 0.0625 inch.
    b. Finish: Directional satin, No. 4.

3. Wing Size: Nominal 3-1/2 by 3-1/2 inches.
4. Corner Radius: 3/16 inch.
5. Mounting: Flat-head, countersunk screws through factory-drilled mounting holes.

2.4 ABUSE-RESISTANT WALL COVERINGS

A. Abuse-Resistant Sheet Wall Covering: Fabricated from semirigid, plastic sheet wall-covering material.

1. Basis-of-Design Product: Subject to compliance with requirements, provide **Construction Specialties, Inc.; Acrovyn Wall Covering** or a comparable product by one of the following:

    a. Koroseal Interior Products, LLC.
    b. Nystrom, Inc.
    c. inpro Corporation.

2. Size: As indicated.
3. Sheet Thickness: 0.060 inch.
4. Color and Texture: As preselected and indicated in Finish Schedule.
5. Height: As indicated.
6. Trim and Joint Moldings: Extruded rigid plastic that matches wall-covering color.
7. Mounting: Adhesive.

2.5 MATERIALS

A. Plastic Materials: Chemical- and stain-resistant, high-impact-resistant plastic with integral color throughout; extruded and sheet material as required, thickness as indicated.

B. Adhesive: As recommended by protection product manufacturer.

1. Verify adhesives have a VOC content of 70 g/L or less.
2. Verify adhesive complies with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

2.6 FABRICATION

A. Fabricate wall and door protection according to requirements indicated for design, performance, dimensions, and member sizes, including thicknesses of components.

B. Factory Assembly: Assemble components in factory to greatest extent possible to minimize field assembly. Disassemble only as necessary for shipping and handling.

C. Quality: Fabricate components with uniformly tight seams and joints and with exposed edges rolled. Provide surfaces free of wrinkles, chips, dents, uneven coloration, and other imperfections. Fabricate members and fittings to produce flush, smooth, and rigid hairline joints.

D. Wood Handrails: Miter corners and ends of wood handrails for returns.

2.7 FINISHES

A. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and wall areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine walls to which wall protection will be attached for blocking, grounds, and other solid backing that have been installed in the locations required for secure attachment of support fasteners.

1. For wall and door protection attached with adhesive, verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Complete finishing operations, including painting, before installing wall and door protection.

B. Before installation, clean substrate to remove dust, debris, and loose particles.

3.3 INSTALLATION

A. Installation Quality: Install wall and door protection according to manufacturer's written instructions, level, plumb, and true to line without distortions. Do not use materials with chips, cracks, voids, stains, or other defects that might be visible in the finished Work.

B. Mounting Heights: Install wall and door protection in locations and at mounting heights indicated on Drawings.

C. Accessories: Provide splices, mounting hardware, anchors, trim, joint moldings, and other accessories required for a complete installation.

1. Provide anchoring devices and suitable locations to withstand imposed loads.
2. Where splices occur in horizontal runs of more than 20 feet, splice aluminum retainers and plastic covers at different locations along the run, but no closer than 12 inches apart.
3. Adjust end and top caps as required to ensure tight seams.

D. Abuse-Resistant Wall Covering: Install top and edge moldings, corners, and divider bars as required for a complete installation.

3.4 CLEANING

A. Immediately after completion of installation, clean plastic covers and accessories using a standard ammonia-based household cleaning agent.

B. Remove excess adhesive using methods and materials recommended in writing by manufacturer.

END OF SECTION

This page is intentionally left blank.

SECTION 10 26 41 – BULLET RESISTANT PANELS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes bullet resistant fiberglass armor panels.

B. Related Sections

1. Section 06 40 23 “Interior Architectural Woodwork” for woodwork to receive bullet resistant fiberglass armor panels.
2. Section 09 29 00 “Gypsum Board” for gypsum board partition assemblies to receive bullet resistant fiberglass armor panels.

1.2 PERFORMANCE REQUIREMENTS

A. Bullet Resistant Fiberglass shall be of the “non-ricochet type”. This design is intended to permit the encapture and retention of an attacking projectile lessening the potential of a random injury or lateral penetration.

B. Bullet Resistant Fiberglass will be rated and tested for UL752 Level 3 protection unless a higher rating is indicated.

1.3 ACTION SUBMITTALS

A. Product Data: Manufacturer’s preprinted brochures, specifications and data in sufficient detail to indicate compliance with the contract documents.

B. Samples: 12 by 12 inch sample of bullet resistant fiberglass panel for each performance/security level required.

1.4 INFORMATIONAL SUBMITTALS

A. Test Reports: UL listing verification and UL752 current test results as provided by Underwriters Laboratories.

B. Manufacturer's Instructions for installation of Bullet Resistant Fiberglass Panels.

1.5 DELIVERY, STORAGE AND HANDLING

A. Deliver materials to the project with the manufacturer’s UL LISTED Labels intact and legible.

B. Handle the material with care to prevent damage.

C. Store the materials inside under cover, stack flat and off the floor.

1.6 WARRANTY

A. All materials and workmanship shall be warranted against defects for a period of two (2) years from the date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Armortex.
2. Total Security Solutions (TSS).
3. Waco Composites.

2.2 BULLET RESISTANT FIBERGLASS MATERIAL

A. Fabricate panels from multiple layers of woven roving ballistic grade fiberglass cloth impregnated with a thermoset polyester resin and compressed into flat rigid sheets designed to provide controlled internal delamination to encapture of a penetrating projectile.

1. Thickness and Weight: 7/16-inch maximum thickness and 5 lb/sq. ft. maximum weight.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install bullet resistant panels in accordance with the manufacturer’s printed recommendations.

B. Adhere bullet resistant panels with industrial adhesive, mastic, screws or bolts.

C. Maintain the bullet resistive rating at junctures with floor slab, roof slab, bullet resistive door frames, bullet resistive window frames, and all required penetrations.

D. Reinforce all joints with a back-up layer of bullet resistive material. The bullet resistance of the joint, as reinforced, shall be at least equal to that of the panel. Minimum width of reinforcing layer at joint shall be 4 inches (2 inches on each panel or a 2-inch minimum overlap)

END OF SECTION

SECTION 10 28 00 - TOILET, BATH, AND LAUNDRY ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Public-use washroom accessories.
2. Public-use shower room accessories.
3. Warm-air dryers.
4. Childcare accessories.
5. Underlavatory guards.
6. Custodial accessories.

B. Related Sections:

1. Section 08 83 00 "Mirrors" for frameless mirrors.
2. Section 09 30 00 "Tiling" for ceramic toilet and bath accessories.
3. Section 10 28 13.63 "Detention Toilet Accessories" for accessories designed for installation in detention facilities.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include the following:

1. Construction details and dimensions.
2. Anchoring and mounting requirements, including requirements for cutouts in other work and substrate preparation.
3. Material and finish descriptions.
4. Features that will be included for Project.
5. Manufacturer's warranty.

B. Samples: Full size, for each accessory item to verify design, operation, and finish requirements.

1. Approved full-size Samples will be returned and may be used in the Work.

C. Product Schedule: Indicating types, quantities, sizes, and installation locations by room of each accessory required.

1. Identify locations using room designations indicated.
2. Identify products using designations indicated.

1.3 INFORMATIONAL SUBMITTALS

A. Warranty: Sample of special warranty.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For toilet and bath accessories to include in maintenance manuals.

1.5 QUALITY ASSURANCE

A. Source Limitations: For products listed together in the same Part 2 articles, obtain products from single source from single manufacturer.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

1.6 COORDINATION

A. Coordinate accessory locations with other work to prevent interference with clearances required for access by people with disabilities, and for proper installation, adjustment, operation, cleaning, and servicing of accessories.

B. Deliver inserts and anchoring devices set into concrete or masonry as required to prevent delaying the Work.

1.7 WARRANTY

A. Special Mirror Warranty: Manufacturer's standard form in which manufacturer agrees to replace mirrors that develop visible silver spoilage defects and that fail in materials or workmanship within specified warranty period.

1. Warranty Period: 15 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Stainless Steel: ASTM A 666, Type 304, 0.031-inch minimum nominal thickness unless otherwise indicated.

B. Brass: ASTM B 19, flat products; ASTM B 16/B 16M, rods, shapes, forgings, and flat products with finished edges; or ASTM B 30, castings.

C. Steel Sheet: ASTM A 1008/A 1008M, Designation CS (cold rolled, commercial steel), 0.036-inch minimum nominal thickness.

D. Galvanized-Steel Sheet: ASTM A 653/A 653M, with G60 hot-dip zinc coating.

E. Galvanized-Steel Mounting Devices: ASTM A 153/A 153M, hot-dip galvanized after fabrication.

F. Fasteners: Screws, bolts, and other devices of same material as accessory unit and tamper-and-theft resistant where exposed, and of galvanized steel where concealed.

G. Chrome Plating: ASTM B 456, Service Condition Number SC 2 (moderate service).

H. Mirrors: ASTM C 1503, Mirror Glazing Quality, clear-glass mirrors, nominal 6.0 mm thick.

I. ABS Plastic: Acrylonitrile-butadiene-styrene resin formulation.

2.2 MANUFACTURER

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated below or comparable product by one of the following:

1. American Specialties, Inc.
2. Bobrick Washroom Equipment, Inc.
3. Bradley Corporation.
4. GAMCO Specialty Accessories; a division of Bobrick Washroom Equipment, Inc.
5. Tubular Specialties Manufacturing, Inc.

2.3 PUBLIC-USE WASHROOM ACCESSORIES

A. Provide accessories with design and characteristics based on Basis-of-Design selections indicated on Drawings.

2.4 PUBLIC-USE SHOWER ROOM ACCESSORIES

A. Provide accessories with design and characteristics based on Basis-of-Design selections indicated on Drawings.

2.5 CHILDCARE ACCESSORIES

A. Provide accessories with design and characteristics based on Basis-of-Design selections indicated on Drawings.

B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated below or comparable product by one of the following:

1. American Specialties, Inc.
2. Brocar Products, Inc.
3. Diaper Deck & Company, Inc.
4. GAMCO Specialty Accessories; a division of Bobrick Washroom Equipment, Inc.
5. Koala Kare Products; a division of Bobrick Washroom Equipment, Inc.
6. SSC, Inc.
7. Tubular Specialties Manufacturing, Inc.

2.6 CUSTODIAL ACCESSORIES

A. Provide accessories with design and characteristics based on Basis-of-Design selections indicated on Drawings.

B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated below or comparable product by one of the following:

1. American Specialties, Inc.
2. Bobrick Washroom Equipment, Inc.
3. Bradley Corporation.
4. GAMCO Specialty Accessories; a division of Bobrick Washroom Equipment, Inc.
5. Tubular Specialties Manufacturing, Inc.

2.7 UNDERLAVATORY GUARDS

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. Plumberex Specialty Products, Inc.
2. Truebro by IPS Corporation.

B. Underlavatory Guard:

1. Description: Insulating pipe covering for supply and drain piping assemblies that prevent direct contact with and burns from piping; allow service access without removing coverings.
2. Material and Finish: Antimicrobial, molded plastic, white.

2.8 FABRICATION

A. General: Fabricate units with tight seams and joints, and exposed edges rolled. Hang doors and access panels with full-length, continuous hinges. Equip units for concealed anchorage and with corrosion-resistant backing plates.

B. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of six keys to Owner's representative.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install accessories according to manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.

B. Grab Bars: Install to withstand a downward load of at least 250 lbf, when tested according to ASTM F 446.

3.2 ADJUSTING AND CLEANING

A. Adjust accessories for unencumbered, smooth operation. Replace damaged or defective items.

B. Remove temporary labels and protective coatings.

C. Clean and polish exposed surfaces according to manufacturer's written recommendations.

END OF SECTION

This page is intentionally left blank.

SECTION 10 43 13 - DEFIBRILLATOR CABINETS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Defibrillator Cabinets.
2. Automated external defibrillators (AED’s).

B. Related Requirements:

1. Section 10 44 13 "Fire Protection Cabinets."

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product. Show door hardware, cabinet type, trim style, and panel style. Include roughing-in dimensions and details showing recessed-, semirecessed-, or surface-mounting method and relationships of box and trim to surrounding construction.

B. Shop Drawings: For defibrillator cabinets. Include plans, elevations, sections, details, and attachments to other work.

C. Samples: For each type of exposed finish required.

1.3 CLOSEOUT SUBMITTALS

A. Maintenance Data: For defibrillator cabinets and AED’s to include in maintenance manuals.

1.4 COORDINATION

A. Coordinate sizes and locations of defibrillator cabinets with wall depths.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.2 DEFIBRILLATOR CABINET

A. Cabinet Type: Suitable for automated electronic defibrillator.

1. Product: Subject to compliance with requirement, provide **JL Industries, Inc.; Activar Construction Products Group, Inc.; Model 1437F12**.

B. Cabinet Construction: Fire-rated and nonrated.

C. Cabinet Material: Cold-rolled steel sheet.

D. Semirecessed Cabinet: One-piece combination trim and perimeter door frame overlapping surrounding wall surface, with exposed trim face and wall return at outer edge (backbend).

1. Rolled-Edge Trim: 3-inch backbend depth.

E. Cabinet Trim Material: Bronze sheet.

F. Door Material: Bronze sheet.

G. Door Style: Fully glazed panel with frame.

H. Door Glazing: 3/16-inch impact resistant acrylic.

I. Door Hardware: Manufacturer's standard clamshell type door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.

1. Provide projecting lever handle with cam-action latch.
2. Provide manufacturer's standard hinge permitting door to open 180 degrees.

J. Accessories:

1. Door Lock: Cam lock that allows door to be opened during emergency by pulling sharply on door handle with cylinder lock, keyed alike to other cabinets.
2. Identification: Lettering to read “In Case of Emergency, Pull Handle Up to Open, Alarm Will Sound” and “Automated External Defibrillator, For Emergency Use By: Trained Rescuers Only” on cabinet door.

a. Location: Applied to cabinet glazing.
b. Application Process: Decals.
c. Lettering Color: Red and Blue, respectively.

3. Local Alarm: Manufacturer's standard siren strobe 110 dB alarm that actuates when defibrillator cabinet door is opened and that is powered by batteries. Alarm deactivates when door is closed.
4. Central Notification: Wire cabinet door duress switch with 4 conductor, 22 AWG (7x30) stranded wire, red CAT6 or equivalent run in conduit with jack installed inside cabinet to nearest IDF to immediately send an emergency notification to security personnel and identifying the AED location.

K. Materials:

1. Cold-Rolled Steel: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B.

a. Finish: Baked enamel or powder coat.

b. Color: White.

2. Copper Alloy, Brass: ASTM B36/B36M alloy Alloy UNS C28000 (muntz metal, 60 percent copper).

a. Finish: As selected by Architect from full range of industry finishes.

2.3 AUTOMATED EXTERNAL DEFIBRILLATORS (AEDs)

A. Products: Subject to compliance with requirements, provide the following:

1. Physio-Control; Lifepak CR Plus.

2.4 FABRICATION

A. Defibrillator Cabinets: Provide manufacturer's standard box (tub) with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated.

1. Weld joints and grind smooth.
2. Provide factory-drilled mounting holes.
3. Prepare doors and frames to receive locks.
4. Install door locks at factory.

B. Cabinet Doors: Fabricate doors according to manufacturer's standards, from materials indicated and coordinated with cabinet types and trim styles.

1. Fabricate door frames with tubular stiles and rails and hollow-metal design, minimum 1/2 inch thick.
2. Miter and weld perimeter door frames.

C. Cabinet Trim: Fabricate cabinet trim in one piece with corners mitered, welded, and ground smooth.

2.5 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM's AMP 500, "Metal Finishes Manual for Architectural and Metal Products," for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces of defibrillator cabinets from damage by applying a strippable, temporary protective covering before shipping.

C. Finish defibrillator cabinets after assembly.

D. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine walls and partitions for suitable framing depth and blocking where recessed cabinets will be installed.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Prepare recesses for recessed defibrillator cabinets as required by type and size of cabinet and trim style.

3.3 INSTALLATION

A. General: Install defibrillator cabinets in locations and at mounting heights indicated or, if not indicated, at heights indicated below:

1. Defibrillator Cabinets: 54 inches above finished floor to top of cabinet.

B. Defibrillator Cabinets: Fasten cabinets to structure, square and plumb.

C. Identification: Apply decals at locations indicated.

D. AED's: Provide one AED installed in each AED cabinet location.

3.4 ADJUSTING AND CLEANING

A. Remove temporary protective coverings and strippable films, if any, as defibrillator cabinets are installed unless otherwise indicated in manufacturer's written installation instructions.

B. Adjust defibrillator cabinet doors to operate easily without binding. Verify that integral locking devices operate properly.

C. On completion of defibrillator cabinet installation, clean interior and exterior surfaces as recommended by manufacturer.

D. Touch up marred finishes, or replace defibrillator cabinets that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by defibrillator cabinet and mounting bracket manufacturers.

E. Replace defibrillator cabinets that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION

SECTION 10 44 13 - FIRE PROTECTION CABINETS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Fire-protection cabinets for the following:

a. Portable fire extinguisher.

B. Related Requirements:

1. Section 104416 "Fire Extinguishers" for portable, hand-carried fire extinguishers accommodated by fire-protection cabinets.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Show door hardware, cabinet type, trim style, and panel style. Include roughing-in dimensions and details showing recessed-, semirecessed-, or surface-mounting method and relationships of box and trim to surrounding construction.

B. Shop Drawings: For fire-protection cabinets.

1. Include plans, elevations, sections, details, and attachments to other work.

C. Samples for Verification: For each type of exposed finish required, prepared on samples 6 by 6 inches square.

1.3 CLOSEOUT SUBMITTALS

A. Maintenance Data: For fire-protection cabinets to include in maintenance manuals.

1.4 COORDINATION

A. Coordinate size of fire-protection cabinets to ensure that type and capacity of fire extinguishers indicated are accommodated.

B. Coordinate sizes and locations of fire-protection cabinets with wall depths.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain fire-protection cabinets, accessories, and fire extinguishers from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

2.3 FIRE-PROTECTION CABINET FEC-1, FRONT OF HOUSE—PUBLIC

A. Cabinet Type: Suitable for fire extinguisher.

1. Basis-of-Design Product: Subject to compliance with requirements, provide **Larsen's Manufacturing Company; Occult Series O-2409** or a comparable product by one of the following:

a. J. L. Industries, Inc.; Activar Construction Products Group, Inc.
b. Nystrom, Inc.
c. Potter Roemer LLC; a Division of Morris Group International.

B. Cabinet Construction: Nonrated.

C. Cabinet Material: Cold-rolled steel sheet.

D. Recessed Cabinet:

1. Trimless with Hidden Flange: Flange of same metal and finish as box overlaps surrounding wall finish and is concealed from view by an overlapping door.

E. Door Material: Copper-alloy bronze sheet.

F. Door Style: Flush opaque panel, frameless, with no exposed hinges.

G. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.

1. Provide projecting door pull and friction latch.
2. Provide concealed hinge, permitting door to open 180 degrees.

H. Accessories:

1. Door Lock: Cam lock that allows door to be opened during emergency by pulling sharply on door handle.
2. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as indicated.

a. Identify fire extinguisher in fire-protection cabinet with the words "FIRE EXTINGUISHER."

1) Location: Applied to cabinet door.
2) Application Process: Pressure-sensitive vinyl letters.
3) Lettering Color: Black, unless red is required by authority-having-jurisdiction.
4) Orientation: Vertical.

I. Materials:

1. Cold-Rolled Steel: ASTM A1008/A1008M, Commercial Steel (CS), Type B.

a. Finish: Baked enamel, TGIC polyester powder coat, HAA polyester powder coat, epoxy powder coat, or polyester/epoxy hybrid powder coat, complying with AAMA 2603.
b. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
c. Color: As selected by Architect from manufacturer's full range.

2. Copper Alloy, Brass: ASTM B36/B36M alloy Alloy UNS C28000 (muntz metal, 60 percent copper).

a. Finish: As selected by Architect from full range of industry finishes.

2.4 FIRE-PROTECTION CABINET FEC-2, BACK-OF-HOUSE

A. Cabinet Type: Suitable for fire extinguisher.

1. Basis-of-Design Product: Subject to compliance with requirements, provide **Larsen's Manufacturing Company; Architectural Series 2409-6R** or a comparable product by one of the following:

a. J. L. Industries, Inc.; Activar Construction Products Group, Inc.
b. Nystrom, Inc.
c. Potter Roemer LLC; a Division of Morris Group International.

B. Cabinet Construction: Nonrated.

C. Cabinet Material: Cold-rolled steel sheet.

D. Semirecessed Cabinet: One-piece combination trim and perimeter door frame overlapping surrounding wall surface, with exposed trim face and wall return at outer edge (backbend).

1. Rolled-Edge Trim: 2-1/2-inch backbend depth.

E. Cabinet Trim Material: Same material and finish as door.

F. Door Material: Steel sheet.

G. Door Style: Solid opaque panel with frame.

H. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.

1. Provide projecting door pull and friction latch.
2. Provide continuous hinge, of same material and finish as trim,, permitting door to open 180 degrees.

I. Accessories:

1. Door Lock: Cam lock that allows door to be opened during emergency by pulling sharply on door handle.
2. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as indicated.

    a. Identify fire extinguisher in fire-protection cabinet with the words "FIRE EXTINGUISHER."

        1) Location: Applied to cabinet door.
        2) Application Process: Pressure-sensitive vinyl letters.
        3) Lettering Color: Black, unless red is required by authority-having-jurisdiction.
        4) Orientation: Vertical.

J. Materials:

1. Cold-Rolled Steel: ASTM A1008/A1008M, Commercial Steel (CS), Type B.

    a. Finish: Baked enamel, TGIC polyester powder coat, HAA polyester powder coat, epoxy powder coat, or polyester/epoxy hybrid powder coat, complying with AAMA 2603.
    b. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
    c. Color: As selected by Architect from manufacturer's full range.

2.5 FIRE-PROTECTION CABINET FEC-3, SECURE PARKIN

A. Cabinet Type: Suitable for fire extinguisher.

1. Basis-of-Design Product: Subject to compliance with requirements, provide **Larsen's Manufacturing Company; Architectural Series 2409-SM** or a comparable product by one of the following:

    a. J. L. Industries, Inc.; Activar Construction Products Group, Inc.
    b. Nystrom, Inc.
    c. Potter Roemer LLC; a Division of Morris Group International.

B. Cabinet Construction: Nonrated.

C. Cabinet Material: Cold-rolled steel sheet.

D. Surface-Mounted Cabinet: Cabinet box fully exposed and mounted directly on wall with no trim.

E. Cabinet Trim Material: Same material and finish as door.

F. Door Material: Steel sheet.

G. Door Style: Solid opaque panel with frame.

H. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.

1. Provide projecting door pull and friction latch.
2. Provide continuous hinge, of same material and finish as trim,, permitting door to open 180 degrees.

I. Accessories:

1. Door Lock: Cam lock that allows door to be opened during emergency by pulling sharply on door handle.
2. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as indicated.

a. Identify fire extinguisher in fire-protection cabinet with the words "FIRE EXTINGUISHER."

1) Location: Applied to cabinet door.
2) Application Process: Pressure-sensitive vinyl letters.
3) Lettering Color: Black, unless red is required by authority-having-jurisdiction.
4) Orientation: Vertical.

J. Materials:

1. Cold-Rolled Steel: ASTM A1008/A1008M, Commercial Steel (CS), Type B.

a. Finish: Baked enamel, TGIC polyester powder coat, HAA polyester powder coat, epoxy powder coat, or polyester/epoxy hybrid powder coat, complying with AAMA 2603.
b. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
c. Color: As selected by Architect from manufacturer's full range.

2.6 FABRICATION

A. Fire-Protection Cabinets: Provide manufacturer's standard box (tub) with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated.

1. Weld joints and grind smooth.
2. Miter corners and grind smooth.
3. Provide factory-drilled mounting holes.
4. Prepare doors and frames to receive locks.

B. Cabinet Doors: Fabricate doors according to manufacturer's standards, from materials indicated and coordinated with cabinet types and trim styles.

1. Fabricate door frames with tubular stiles and rails and hollow-metal design, minimum 1/2 inch thick.
2. Miter and weld perimeter door frames and grind smooth.

C. Cabinet Trim: Fabricate cabinet trim in one piece with corners mitered, welded, and ground smooth.

2.7 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM's AMP 500, "Metal Finishes Manual for Architectural and Metal Products," for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces of fire-protection cabinets from damage by applying a strippable, temporary protective covering before shipping.

C. Finish fire-protection cabinets after assembly.

D. Appearance of Finished Work: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine walls and partitions for suitable framing depth and blocking where recessed and semirecessed cabinets will be installed.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Prepare recesses for recessed and semirecessed fire-protection cabinets as required by type and size of cabinet and trim style.

3.3 INSTALLATION

A. General: Install fire-protection cabinets in locations and at mounting heights indicated or, if not indicated, at heights acceptable to authorities having jurisdiction.

B. Fire-Protection Cabinets: Fasten cabinets to structure, square and plumb.

1. Fasten mounting brackets to inside surface of fire-protection cabinets, square and plumb.

C. Identification:

1. Apply vinyl lettering at locations indicated.

3.4 ADJUSTING AND CLEANING

A. Remove temporary protective coverings and strippable films, if any, as fire-protection cabinets are installed unless otherwise indicated in manufacturer's written installation instructions.

B. Adjust fire-protection cabinet doors to operate easily without binding. Verify that integral locking devices operate properly.

C. On completion of fire-protection cabinet installation, clean interior and exterior surfaces as recommended by manufacturer.

D. Touch up marred finishes, or replace fire-protection cabinets that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by fire-protection cabinet and mounting bracket manufacturers.

E. Replace fire-protection cabinets that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION

This page is intentionally left blank.

SECTION 10 44 16 - FIRE EXTINGUISHERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes portable, hand-carried fire extinguishers and mounting brackets for fire extinguishers.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product. Include rating and classification, material descriptions, dimensions of individual components and profiles, and finishes for fire extinguisher and mounting brackets.

B. Product Schedule: For fire extinguishers. Coordinate final fire-extinguisher schedule with fire-protection cabinet schedule to ensure proper fit and function. Use same designations indicated on Drawings.

1.3 INFORMATIONAL SUBMITTALS

A. Warranty: Sample of special warranty.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fire extinguishers to include in maintenance manuals.

1.5 COORDINATION

A. Coordinate type and capacity of fire extinguishers with fire-protection cabinets to ensure fit and function.

1.6 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace fire extinguishers that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

   a. Failure of hydrostatic test according to NFPA 10 when testing interval required by NFPA 10 is within the warranty period.
   b. Faulty operation of valves or release levers.

2. Warranty Period: Six years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Portable Fire Extinguishers."

B. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.

2.2 PORTABLE, HAND-CARRIED FIRE EXTINGUISHERS

A. Fire Extinguishers: Type, size, and capacity for each fire-protection cabinet and mounting bracket indicated.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Activar Construction Products Group, Inc. - JL Industries.
    b. Amerex Corporation.
    c. Ansul; brand of Johnson Controls International plc, Building Solutions North America.
    d. Babcock-Davis.
    e. Badger Fire Protection.
    f. Larsens Manufacturing Company.
    g. Nystrom.
    h. Potter Roemer LLC; a Division of Morris Group International.

2. Source Limitations: Obtain fire extinguishers, fire-protection cabinets, and accessories, from single source from single manufacturer.
3. Valves: Manufacturer's standard.
4. Handles and Levers: Manufacturer's standard.
5. Instruction Labels: Include pictorial marking system complying with NFPA 10, Appendix B, and bar coding for documenting fire-extinguisher location, inspections, maintenance, and recharging.

B. Multipurpose Dry-Chemical Type in Steel Container: UL-rated 4-A:60-B:C, 10-lb nominal capacity, with monoammonium phosphate-based dry chemical in enameled-steel container.

2.3 MOUNTING BRACKETS

A. Mounting Brackets: Manufacturer's standard galvanized steel, designed to secure fire extinguisher to wall or structure, of sizes required for types and capacities of fire extinguishers indicated, with plated or red baked-enamel finish.

1. Source Limitations: Obtain mounting brackets and fire extinguishers from single source from single manufacturer.

B. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as indicated by Architect.

1. Identify bracket-mounted fire extinguishers with the words "FIRE EXTINGUISHER" in red letter decals applied to mounting surface.

    a. Orientation: Vertical.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine fire extinguishers for proper charging and tagging.

1. Remove and replace damaged, defective, or undercharged fire extinguishers.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Install fire extinguishers and mounting brackets in locations indicated and in compliance with requirements of authorities having jurisdiction.

1. Mounting Brackets: 54 inches above finished floor to top of fire extinguisher.

B. Mounting Brackets: Fasten mounting brackets to surfaces, square and plumb, at locations indicated.

3.3 SCHEDULE

A. Provide extinguishers as indicated but not less than one fire extinguisher per 6,000 sq. ft. of building area.

END OF SECTION

This page is intentionally left blank.

SECTION 10 45 13 - PHOTOLUMINESCENT EGRESS PATH MARKINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes photoluminescent egress path markings.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:

1. Product Data: For adhesives, indicating VOC content.
2. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting materials.

C. Shop Drawings: For photoluminescent egress path markings.

1. Include plans, elevations, and details.

D. Samples: For each exposed product and for each color and texture specified, 6 inches long or full size.

1.3 INFORMATIONAL SUBMITTALS

A. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for luminance level of photoluminescent egress path markings.

B. Sample Warranties: For special warranties.

1.4 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to replace photoluminescent egress path markings that fail in materials or workmanship within specified warranty period.

1. Failure includes, but is not limited to, decline in luminance below specified brightness level.
2. Warranty Period: 25 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Luminance: Comply with one of the following; testing by a qualified testing agency:

1. UL 1994.
2. ASTM E2072; except that the charging source is to be 1 foot-candle of fluorescent illumination for 60 min., and the minimum luminance is to be 30 millicandelas/sq. m after 10 min. and 5 millicandelas/sq. m after 90 min.

2.2 PHOTOLUMINESCENT EGRESS PATH MARKINGS

A. Photoluminescent Egress Path Markings: Photoluminescent products containing no radioactive materials and requiring no electrical power.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. 2/90 Sign Systems.
b. Active Safety Corporation.
c. American PERMALIGHT, Inc.
d. Balco; a CSW Industrials Company.
e. Bright Path Lighting, inc.
f. Ecoglo, Inc.
g. Everglow NA, Inc.
h. GBC Safety Glow.
i. JALITE Inc.
j. Jessup Manufacturing Company.
k. Nystrom, Inc.
l. Zero International; Allegion plc.

B. Stair-and-Landing Nosing Markings:

1. Slip-resistive 1-inch- wide stripes mounted to extruded-aluminum nosings.

C. Handrail Markings: Self-adhesive semi-rigid stripes; 1 inch wide.

D. Floor-Mounted Perimeter Markings: Self-adhesive tape stripes; 1 inch wide.

E. Wall-Mounted Perimeter Markings:

1. Self-adhesive tape stripes; 1 inch wide.

F. Obstacle Marking: Self-adhesive stripe with alternating diagonal bands of black and photoluminescent material.

G. Door Frame Markings:

1. Self-adhesive tape stripes 1 inch wide.

H. Door Hardware Markings: Square self-adhesive sticker, 4 inches by 4 inches.

I. Exit Signs: Rigid plastic or aluminum sign for low-level mounting, with emergency exit symbol complying with NFPA 170; with self-adhesive backing; with a minimum height of 4 inches; and with running man symbol facing right or left to suit installation condition.

J. Extruded Aluminum: ASTM B221, Alloy 6063.

K. Adhesive: As recommended by manufacturer.

1. Verify adhesives have a VOC content of 70 g/L or less.
2. Verify adhesive complies with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

PART 3 - EXECUTION

3.1 PREPARATION

A. Comply with manufacturer's written instructions for surface preparation.

B. Clean and prepare surfaces to achieve a smooth, dry, clean surface free of flaking, unsound coatings, cracks, defects, projections, depressions, and substances that could impair bond between photoluminescent egress path markings and wall or floor surfaces.

3.2 INSTALLATION

A. General: Install photoluminescent egress path markings according to manufacturer's written instructions.

B. Install aluminum nosings with adhesive and mechanical fasteners.

END OF SECTION

This page is intentionally left blank.

SECTION 10 51 13 - METAL LOCKERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Knocked-down corridor lockers.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of metal locker.

B. Sustainable Design Submittals:

1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.
2. Environmental Product Declaration: For each product.
3. Health Product Declaration: For each product.
4. Sourcing of Raw Materials: Corporate sustainability report for each manufacturer.

C. Shop Drawings: For metal lockers.

1. Include plans, elevations, sections, and attachment details.
2. Show locker trim and accessories.
3. Include locker identification system and numbering sequence.

D. Samples for Verification: For the following products, in manufacturer's standard size:

1. Lockers and equipment.

1.3 INFORMATIONAL SUBMITTALS

A. Sample Warranty: For special warranty.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For adjusting, repairing, and replacing locker doors and latching mechanisms to include in maintenance manuals.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Do not deliver metal lockers until spaces to receive them are clean, dry, and ready for their installation.

1.6 FIELD CONDITIONS

A. Field Measurements: Verify actual dimensions of recessed openings by field measurements before fabrication.

1.7 COORDINATION

A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of work specified in other Sections to ensure that metal lockers can be supported and installed as indicated.

1.8 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of metal lockers that fail in materials or workmanship, excluding finish, within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures.
b. Faulty operation of latches and other door hardware.

2. Damage from deliberate destruction and vandalism is excluded.
3. Warranty Period for Knocked-Down Metal Lockers: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain metal lockers and accessories from single source from single locker manufacturer.

1. Obtain locks from single lock manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Accessibility Standard: For lockers indicated to be accessible, comply with applicable provisions in the USDOJ's "2010 ADA Standards for Accessible Design" and ICC A117.1.

2.3 KNOCKED-DOWN CORRIDOR LOCKERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide **Penco Products, Inc; Vanguard Locker** or a comparable product by one of the following:

1. ASI Storage Solutions.
2. Hadrian Inc.; Zurn Industries, LLC.
3. Republic Storage Systems, LLC.

B. Doors: One piece; fabricated from 0.060-inch nominal-thickness steel sheet; formed into channel shape with double bend at vertical edges and with right-angle single bend at horizontal edges.

1. Doors less than 12 inches wide may be fabricated from 0.048-inch nominal-thickness steel sheet.
2. Doors for box lockers less than 15 inches wide may be fabricated from 0.048-inch nominal-thickness steel sheet.
3. Reinforcement: Manufacturer's standard reinforcing angles, channels, or stiffeners for doors more than 15 inches wide; welded to inner face of doors.
4. Stiffeners: Manufacturer's standard full-height stiffener fabricated from 0.048-inch nominal-thickness steel sheet; welded to inner face of doors.
5. Door Style: Vented panel as follows:

    a. Louvered Vents: No fewer than three louver openings at top and bottom for double-tier lockers.

C. Body: Assembled by riveting or bolting body components together. Fabricate from unperforated steel sheet with thicknesses as follows:

1. Tops, Bottoms, and Intermediate Dividers: 0.024-inch nominal thickness, with single bend at sides.
2. Backs and Sides: 0.024-inch nominal thickness, with full-height, double-flanged connections.
3. Shelves: 0.024-inch nominal thickness, with double bend at front and single bend at sides and back.

D. Frames: Channel formed; fabricated from 0.060-inch nominal-thickness steel sheet; lapped and factory welded at corners; with top and bottom main frames factory welded into vertical main frames. Form continuous, integral, full-height door strikes on vertical main frames.

1. Cross Frames between Tiers: Channel formed and fabricated from same material as main frames; welded to vertical main frames.

E. Hinges: Welded to door and attached to door frame with no fewer than two factory-installed rivets per hinge that are completely concealed and tamper resistant when door is closed; fabricated to swing 180 degrees.

1. Hinges: Manufacturer's standard, steel, continuous or knuckle type.

F. Recessed Door Handle and Latch: Stainless steel cup with integral door pull, recessed so locking device does not protrude beyond door face; pry and vandal resistant.

1. Multipoint Latching: Finger-lift latch control designed for use with built-in combination locks, built-in key locks, or padlocks; positive automatic latching and prelocking.

    a. Latch Hooks: Equip doors 48 inches and higher with three latch hooks and doors less than 48 inches high with two latch hooks; fabricated from 0.105-inch nominal-thickness steel sheet; welded or riveted to full-height door strikes; with resilient silencer on each latch hook.
    b. Latching Mechanism: Manufacturer's standard, rattle-free latching mechanism and moving components isolated to prevent metal-to-metal contact, and incorporating a prelocking device that allows locker door to be locked while door is open and then closed without unlocking or damaging lock or latching mechanism.

G. Identification Plates: Manufacturer's standard, etched, embossed, or stamped aluminum plates, with numbers and letters at least 3/8 inch high.

H. Hooks: Manufacturer's standard ball-pointed hooks, aluminum or steel; zinc plated.

I. Coat Rods: Manufacturer's standard.

J. Continuous Zee Base: Fabricated from 0.060-inch nominal-thickness steel sheet.

1. Height: 4 inches.

K. Finished End Panels: Fabricated from 0.024-inch nominal-thickness steel sheet to cover unused penetrations and fasteners, except for perimeter fasteners, at exposed ends of nonrecessed metal lockers; finished to match lockers.

L. Materials:

1. Cold-Rolled Steel Sheet: ASTM A1008/A1008M, Commercial Steel (CS), Type B, suitable for exposed applications.

M. Finish: Baked enamel or powder coat.

1. Color: As selected by Architect from manufacturer's full range.

2.4 FABRICATION

A. Fabricate metal lockers square, rigid, without warp, and with metal faces flat and free of dents or distortion. Make exposed metal edges safe to touch and free of sharp edges and burrs.

1. Form body panels, doors, shelves, and accessories from one-piece steel sheet unless otherwise indicated.
2. Provide fasteners, filler plates, supports, clips, and closures as required for complete installation.

B. Fabricate each metal locker with an individual door and frame; individual top, bottom, and back; and common intermediate uprights separating compartments.

C. Equipment: Provide each locker with an identification plate and the following equipment:

1. Single-Tier Units: Shelf, one double-prong ceiling hook, and two single-prong wall hooks.

2. Double-Tier Units: One double-prong ceiling hook and two single-prong wall hooks.
3. Triple-Tier Units: One double-prong ceiling hook.

D. Knocked-Down Construction: Fabricate metal lockers by assembling at Project site, using manufacturer's nuts, bolts, screws, or rivets.

E. Accessible Lockers: Fabricate as follows:

1. Locate bottom shelf no lower than 15 inches above the floor.
2. Where hooks, coat rods, or additional shelves are provided, locate no higher than 48 inches above the floor.

F. Continuous Zee Base: Fabricated in lengths as long as practical to enclose base and base ends; finished to match lockers.

G. Finished End Panels: Fabricated to conceal unused penetrations and fasteners, except for perimeter fasteners, at exposed ends of nonrecessed metal lockers; finished to match lockers.

2.5 ACCESSORIES

A. Fasteners: Zinc- or nickel-plated steel, slotless-type, exposed bolt heads; with self-locking nuts or lock washers for nuts on moving parts.

B. Anchors: Material, type, and size required for secure anchorage to each substrate.

1. Provide nonferrous-metal or hot-dip galvanized anchors and inserts on inside face of exterior walls for corrosion resistance.
2. Provide toothed-steel or lead expansion sleeves for drilled-in-place anchors.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine walls and floors or support bases, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install lockers level, plumb, and true; shim as required, using concealed shims.

1. Anchor locker runs at ends and at intervals recommended by manufacturer, but not more than 36 inches o.c. Using concealed fasteners, install anchors through backup reinforcing plates, channels, or blocking as required to prevent metal distortion.

2. Anchor single rows of metal lockers to walls near top and bottom of lockers.

B. Knocked-Down Lockers: Assemble with manufacturer's standard fasteners, with no exposed fasteners on door faces or face frames.

C. Equipment:

1. Attach hooks with at least two fasteners.
2. Identification Plates: Identify metal lockers with identification indicated on Drawings.

a. Attach plates to each locker door, near top, centered, with at least two aluminum rivets.
b. Attach plates to upper shelf of each open-front metal locker, centered, with a least two aluminum rivets.

D. Trim: Fit exposed connections of trim, fillers, and closures accurately together to form tight, hairline joints, with concealed fasteners and splice plates.

3.3 ADJUSTING

A. Clean, lubricate, and adjust hardware. Adjust doors and latches to operate easily without binding.

3.4 PROTECTION

A. Protect metal lockers from damage, abuse, dust, dirt, stain, or paint. Do not permit use during construction.

B. Touch up marred finishes, or replace metal lockers that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by locker manufacturer.

END OF SECTION

SECTION 10 51 16 - WOOD LOCKERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Wood-faced wood lockers.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of wood locker.

B. Sustainable Design Submittals:

1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.
2. Environmental Product Declaration: For each product.
3. Health Product Declaration: For each product.
4. Sourcing of Raw Materials: Corporate sustainability report for each manufacturer.
5. Chain-of-Custody Certificates: For certified wood products. Include statement of costs.
6. Chain-of-Custody Qualification Data: For manufacturer and vendor.
7. Laboratory Test Reports: For composite wood products, indicating compliance with requirements for low-emitting materials.
8. Product Data: For adhesives, indicating VOC content.
9. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting materials.

C. Shop Drawings: For wood lockers.

1. Include plans, elevations, sections, and attachment details.
2. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections.
3. Show locations and sizes of cutouts and holes for items installed in lockers.
4. Show locker fillers, trim, base, sloping tops, and accessories.
5. Show locker identification system and numbering sequence.

D. Samples for Verification: For the following products:

1. Solid wood with transparent finish, not less than 50 sq. in., for each species and cut, finished on one side and one edge.
2. Wood-faced panels with transparent finish, not less than 8 by 10 inches, for each species and cut. Include at least one face-veneer seam and finish as specified.
3. Thermoset decorative-overlay-surfaced panels, not less than 8 by 10 inches, for each type, color, pattern, and surface finish.

4. Corner pieces of locker front frame joints between stiles and rail, as well as exposed end pieces, not less than 18 inches wide by 18 inches high by 6 inches deep.
5. Exposed cabinet hardware and accessories, one unit for each type and finish.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Sample Warranty: For special warranty.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For adjusting, repairing, and replacing locker doors and latching mechanisms to include in maintenance manuals.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Wood locker doors, complete with specified door hardware. Furnish no fewer than two doors of each type and color installed.
2. Units of the following locker hardware items equal to 10 percent of amount installed for each type and finish installed, but no fewer than five units:

a. Hinges.
b. Pulls.
c. Blank identification plates.
d. Hooks.

1.6 QUALITY ASSURANCE

A. Certified Wood: Provide an invoice including vendor's chain-of-custody number, product cost, and entity being invoiced.

B. Vendor Qualifications: A vendor that is certified for chain of custody by an FSC-accredited certification body.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Do not deliver lockers until painting and similar operations that could damage lockers have been completed in installation areas. If lockers must be stored in other-than-installation areas, store only in areas where environmental conditions are the same as those in final installation location, and comply with requirements specified in "Field Conditions" Article.

1.8 FIELD CONDITIONS

A. Environmental Limitations: Do not deliver or install wood lockers until building is enclosed, wet-work is complete, and HVAC system is operating and maintaining temperature between 60 and 90 deg F during the remainder of the construction period.

B. Established Dimensions: Where wood lockers are indicated to fit to other construction, establish dimensions for areas where lockers are to fit. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

1.9 COORDINATION

A. Coordinate sizes and locations of concealed wood support bases.

1.10 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of lockers that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures.
b. Faulty operation of locks and other hardware.
c. Deterioration of wood, wood finishes, and other materials beyond normal use.

2. Warranty Period: Three years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Accessibility Standard: For lockers indicated to be accessible, comply with applicable provisions in the USDOJ's "2010 ADA Standards for Accessible Design" and ICC A117.1.

2.2 WOOD-FACED WOOD LOCKERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide **Hollman, Inc; Flat Panel Wood Veneer Model A** or a comparable product by one of the following:

1. Classic Woodworking, LLC.
2. Club Resource Group.
3. Famous Lockers.
4. Ideal Products, Inc.
5. List Industries Inc.
6. Treeforms.

B. Construction Style: Reveal overlay.

1. Reveal Dimension: 1/2 inch.

C. Final Assembly: Manufacturer's standard factory assembly.

D. Locker Body: Fabricated from particleboard-core panels covered on both sides with thermoset decorative overlay.

1. Side Panels: Manufacturer's standard 3/4 or 5/8 inch thick.
2. Back Panel: Manufacturer's standard 1/2 or 3/8 inch thick.
3. Top Panel: Manufacturer's standard 3/4 or 5/8 inch thick.
4. Bottom Panel: Manufacturer's standard 3/4 or 5/8 inch thick.
5. Exposed Panel Edges: 1-mm-thick PVC.

E. Flat-Panel, Wood-Faced Doors: Stiles, rails, and center panel fabricated from 3/4-inch-thick, wood-faced, medium-density fiberboard.

1. Wood Veneer: Species and cut as indicated on Finish Schedule.

F. End Panels: Match style, material, construction, and finish of wood-faced wood doors.

G. Shelves: Fabricated from particleboard-core panels covered on both sides with thermoset decorative overlay; fixed.

1. Thickness: 5/8 inch.
2. Exposed Edges: 1-mm-thick PVC.

H. Corners and Filler Panels: 3/4-inch-thick panel. Match style, material, construction, and finish of wood-faced wood doors.

I. Continuous Finish Base: Wood-faced, 3/4-inch-thick panel that matches door faces; fabricated in lengths as long as practical to enclose base and base ends of lockers.

J. Grain Matching: Run and match grain vertically for doors and fixed panels.

K. Veneer Matching:

1. None required; select and arrange veneers for compatible grain and color.

L. Transparent Finish: Manufacturer's standard two-coat, clear, catalyzed lacquer finish with sanding between coats. Seal with moisture-resistant topcoat.

1. Stain: As preselected and indicated in Finish Schedule.

M. Factory finish wood lockers as specified in this Section. Defer only final touchup, cleaning, and polishing until after installation.

1. Preparations for Finishing: Sand, fill countersunk fasteners, seal concealed surfaces, and perform similar preparations for finishing lockers, as applicable to each unit of the Work.
2. Backpriming: Apply one coat of sealer or primer, compatible with finish coats, to concealed surfaces of wood lockers that do not have finish materials applied. Apply two coats to concealed backs and ends of panels.

2.3 MATERIALS

A. Regional Materials: To the extent required to comply with the minimum criteria specified in Section 01 81 13.14 “Sustainable Design Requirements,” manufacture wood products within 100 miles of Project site from materials that have been extracted, harvested, or recovered, as well as manufactured, within 100 miles of Project site.

B. Certified Wood: Certify wood products as "FSC Pure" or "FSC Mixed Credit" in accordance with FSC STD-01-001 and FSC STD-40-004.

1. Recycled Content of MDF and Particleboard: Provide products with postconsumer recycled content plus one-half of preconsumer recycled content to the extent required to comply with the minimum criteria specified in Section 01 81 13.14 “Sustainable Design Requirements.”
2. Composite Wood Products: Verify products are made using ultra-low-emitting formaldehyde resins, as defined in the California Air Resources Board's "Airborne Toxic Control Measure to Reduce Formaldehyde Emissions from Composite Wood Products," or are made with no added formaldehyde.

C. Composite Wood: Provide materials that comply with requirements of referenced quality standard for each type of woodwork and quality grade specified unless otherwise indicated.

1. Thermoset Decorative Panels: Particleboard or medium-density fiberboard finished with thermally fused, melamine-impregnated decorative paper and complying with requirements of NEMA LD 3, Grade VGL, for Test Methods 3.3, 3.4, 3.6, 3.8, and 3.10.
2. Particleboard: ANSI A208.1, Grade M-2.
3. Veneer-Faced Panel Products (Hardwood Plywood): HPVA HP-1.

D. Adhesives: Use adhesives that meet the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

E. Furring, Blocking, Shims, and Hanging Strips: Fire-retardant-treated softwood lumber, kiln dried to less than 15 percent moisture content.

F. Anchors: Material, type, size, and finish as required for each substrate for secure anchorage. Provide metal expansion sleeves or expansion bolts for post-installed anchors. Use nonferrous-metal or hot-dip galvanized anchors and inserts at inside face of exterior walls and at floors.

2.4 HARDWARE

A. Frameless Hinges (European Type): Fully concealed, self-closing, nickel-plated steel, with not less than 125 degrees of opening.

1. Provide two hinges for doors 35 inches high and less.
2. Provide three hinges for doors more than 36 inches and less than 59 inches high.
3. Provide four hinges for doors more than 60 inches high.

B. Knobs: Metal; back mounted; 1-inch-diameter, ball shape.

C. Accessible Handle: Metal, fixed, graspable lever handle and rose trim; surface mounted.

D. Hooks: Manufacturer's standard, ball-pointed aluminum or steel; finished to match other locker hardware. Attach hooks with at least two fasteners.

1. Provide two single-prong wall hooks for each compartment of single-tier lockers.

E. Coat Rods: 3/4-inch-diameter steel; finished to match other locker hardware.

1. Provide coat rods as indicated on Drawings.
2. Provide coat rod for each compartment of single-tier lockers.

F. Exposed Hardware Finish:

1. Satin brass unless otherwise indicated.
2. Unless otherwise indicated, provide finish that complies with BHMA A156.18 for BHMA finish number indicated.

a. Satin Brass, Clear Coated: ANSI/BHMA 606 for brass base; ANSI/BHMA 633 for steel base.

2.5 FABRICATION

A. Fabricate each locker with shelves, an individual door and frame, an individual top, a bottom, and a back, and with common intermediate uprights separating compartments.

1. Fabricate lockers to dimensions, profiles, and details indicated.
2. Ease edges of corners of solid-wood members to 1/16-inch radius.

B. Fabricate lockers square, rigid, without warp, and with finished faces flat and free of dents, scratches, and chips. Accurately factory machine components for attachments. Make joints tight and true.

1. Fabricate lockers using manufacturer's standard construction, with joints made with dowels, dados, or rabbets. Dado side panels to receive shelving except where indicated to be adjustable.

C. Accessible Lockers: Fabricate as follows:

1. Locate bottom shelf no lower than 15 inches above the floor.
2. Where hooks, coat rods, or additional shelves are provided, locate no higher than 48 inches above the floor.

D. Venting: Fabricate lockers with space between doors and locker assembly of not less than 1/4 inch.

E. Number Identification Plates: Inlay number plates flush in each locker door, near top, centered.

F. Complete fabrication, including assembly, finishing, and hardware application, to maximum extent possible, before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.

1. Use only manufacturer's nuts, bolts, screws, and other devices for assembly.

G. Shop cut openings, to maximum extent possible, to receive hardware, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine walls and floors or support bases, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Verify that furring is attached to concrete and masonry walls that are to receive lockers.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Condition lockers to average prevailing humidity conditions in installation areas before installation.

B. Before installing lockers, examine factory-fabricated work for completeness and complete work as required, including removal of packing.

3.3 INSTALLATION

A. Install lockers level, plumb, and true; use concealed shims.

B. Connect groups of lockers together with manufacturer's standard fasteners, through predrilled holes, with no exposed fasteners on face frames. Fit lockers accurately together to form flush, tight, hairline joints.

C. Install lockers without distortion so doors and drawers fit openings properly and are accurately aligned. Adjust hardware to center doors and drawers in openings, providing unencumbered operation. Complete installation of hardware and accessory items as indicated.

1. Installation Tolerance: No more than 1/8 inch in 96-inch sag, bow, or other variation from a straight line. Shim as required with concealed shims.
2. Maintain veneer sequence matching of wood-faced wood lockers.

D. Locker Anchorage:

1. Fasten lockers through wood locker base, at ends, and not more than 36 inches o.c. with No. 8 flush-head wood screws sized for 1-inch penetration into wood base.

E. Scribe and cut corner and filler panels to fit adjoining work using fasteners concealed where practical. Repair damaged finish at cuts.

F. Install number identification plates after lockers are in place.

1. Attach number identification plate on each locker door, near top, centered, with at least two screws with finish matching the plate.

G. Provide protective mat at each shoe shelf.

3.4 ADJUSTING

A. Clean, lubricate, and adjust hardware. Adjust doors and drawers to operate easily without binding. Verify that integral locking devices operate properly.

3.5 PROTECTION

A. Protect lockers from damage, abuse, dust, dirt, stain, or paint. Do not permit use during construction.

B. Touch up marred finishes, or replace lockers that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by locker manufacturer.

END OF SECTION

SECTION 10 51 23 - PLASTIC-LAMINATE-CLAD LOCKERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes plastic-laminate-clad wood lockers and related benches.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of locker and bench.

B. Sustainable Design Submittals:

1. Environmental Product Declaration: For each product.
2. Health Product Declaration: For each product.
3. Sourcing of Raw Materials: Corporate sustainability report for each manufacturer.
4. Chain-of-Custody Certificates: For certified wood products. Include statement of costs.
5. Chain-of-Custody Qualification Data: For manufacturer and vendor.
6. Laboratory Test Reports: For composite wood products, indicating compliance with requirements for low-emitting materials.
7. Product Data: For adhesives, indicating VOC content.
8. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting materials.

C. Shop Drawings: For plastic-laminate-clad wood lockers.

1. Include plans, elevations, sections, and attachment details.
2. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections.
3. Show locations and sizes of cutouts and holes for items installed in lockers.
4. Show locker fillers, trim, base, sloping tops, and accessories.
5. Show locker identification system and numbering sequence.

D. Samples for Verification: For the following products:

1. Plastic-laminate-clad panels, not less than 8 by 10 inches, for each type, color, pattern, and surface finish.
2. Thermoset decorative-overlay-surfaced panels, not less than 8 by 10 inches, for each type, color, pattern, and surface finish.
3. Exposed cabinet hardware and accessories, one unit for each type and finish.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Sample Warranty: For special warranty.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For adjusting, repairing, and replacing locker doors and latching mechanisms to include in maintenance manuals.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer that is certified for chain of custody by an FSC-accredited certification body.

B. Vendor Qualifications: A vendor that is certified for chain of custody by an FSC-accredited certification body.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Do not deliver lockers until painting and similar operations that could damage lockers have been completed in installation areas. If lockers must be stored in other-than-installation areas, store only in areas where environmental conditions are the same as those in final installation location, and comply with requirements specified in "Field Conditions" Article.

1.7 FIELD CONDITIONS

A. Environmental Limitations: Do not deliver or install lockers until building is enclosed, wet-work is complete, and HVAC system is operating and maintaining temperature between 60 and 90 deg F and relative humidity between 25 and 55 percent during the remainder of the construction period.

B. Field Measurements: Where lockers are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings.

1. Locate concealed framing, blocking, and reinforcements that support lockers by field measurements before being enclosed, and indicate measurements on Shop Drawings.

1.8 COORDINATION

A. Coordinate sizes and locations of concealed wood support bases.

B. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of work specified in other Sections to ensure that lockers can be supported and installed as indicated.

1.9 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of lockers that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures.
b. Faulty operation of locks or hardware.
c. Deterioration of wood, finishes, and other materials beyond normal use.

2. Warranty Period: Three years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Accessibility Standard: For lockers indicated to be accessible, comply with applicable provisions in the USDOJ's "2010 ADA Standards for Accessible Design" and ICC A117.1.

2.2 PLASTIC-LAMINATE-CLAD WOOD LOCKERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide **Hollman, Inc; Classic Collection** or a comparable product by one of the following:

1. Classic Woodworking, LLC.
2. Club Resource Group.
3. Famous Lockers, Inc.
4. Ideal Products, Inc.
5. Legacy Lockers.
6. List Industries Inc.
7. Treeforms.

B. Certified Wood: Wood products shall be certified as "FSC Pure" or "FSC Mixed Credit" according to FSC STD-01-001 and FSC STD-40-004.

C. Construction Style: Flush overlay.

D. Final Assembly: Manufacturer's standard factory assembly.

E. Locker Body: Fabricated from particleboard-core panels covered on both sides with thermoset decorative overlay.

1. Top, Sides, Bottom and Back Panels: Manufacturer's standard 3/4 or 5/8 inch thick.
2. Exposed Panel Edges: 1.5-mm-thick PVC.

F. Plastic-Laminate-Clad Wood Doors: High-pressure decorative laminate, Grade VGS, over both sides of fire-retardant-particleboard core.

1. Thickness: Manufacturer's standard 3/4 or 5/8 inch thick.
2. Panel Edges: 1.5-mm-thick PVC.

G. End Panels: Match style, material, construction, and finish of plastic-laminate-clad wood doors.

H. Corners and Filler Panels: 3/4-inch- thick panels. Match style, material, construction, and finish of plastic-laminate-clad wood doors.

I. Continuous Finish Base: Plastic-laminate-clad, 3/4-inch- thick panel that matches door faces; fabricated in lengths as long as practical to enclose base and base ends of lockers.

J. Size: Height, width and depth as indicated.

K. Configuration: Two-tier, interlocking zee shaped unless otherwise indicated on Drawings.

L. Plastic-Laminate Colors, Patterns, and Finishes:

1. Custom laminate as preselected and indicated in Finish Schedule.

2.3 MATERIALS

A. Composite Wood: Provide materials that comply with requirements of referenced quality standard for each type of woodwork and quality grade specified unless otherwise indicated.

1. Composite Wood Products: Products shall be made using ultra-low-emitting formaldehyde resins as defined in the California Air Resources Board's "Airborne Toxic Control Measure to Reduce Formaldehyde Emissions from Composite Wood Products" or shall be made with no added formaldehyde.
2. Thermoset Decorative Panels: Particleboard or medium-density fiberboard finished with thermally fused, melamine-impregnated decorative paper and complying with requirements of NEMA LD 3, Grade VGL, for Test Methods 3.3, 3.4, 3.6, 3.8, and 3.10.
3. Particleboard: ANSI A208.1, Grade M-2.

B. High-Pressure Decorative Laminate: NEMA LD 3, grades as follows:

1. Vertical Surfaces: Grade VGS.

C. Fire-Retardant-Treated Materials: Where fire-retardant-treated materials are indicated, use materials impregnated with fire-retardant chemical formulations indicated by a pressure process or other means acceptable to authorities having jurisdiction to produce products with fire-test-response characteristics specified.

1. Do not use material that is warped, discolored, or otherwise defective.
2. Use fire-retardant-treatment formulations that do not bleed through or otherwise adversely affect finishes. Do not use colorants in solution to distinguish treated material from untreated material.
3. Fire-Retardant Particleboard: Panels made from softwood particles and fire-retardant chemicals mixed together at time of panel manufacture to achieve flame-spread index of 25 or less and smoke-developed index of 25 or less according to ASTM E84:

a. Panels 3/4 Inch Thick and Less: ANSI A208.1, Grade M-2, except for the following minimum properties: density, 45 lb/cu. ft.; modulus of rupture, 1600 psi; modulus of

elasticity, 300,000 psi; internal bond, 80 psi; and screw-holding capacity on face and edge, 250 and 225 lbf, respectively.

D. Adhesives: Use adhesives that meet the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

E. Furring, Blocking, Shims, and Hanging Strips: Softwood or hardwood lumber, kiln dried to less than 15 percent moisture content.

F. Anchors: Material, type, size, and finish as required for each substrate for secure anchorage. Provide metal expansion sleeves or expansion bolts for post-installed anchors. Use nonferrous-metal or hot-dip galvanized anchors and inserts at inside face of exterior walls and at floors.

2.4 HARDWARE

A. Digital Keypad Lock: Battery-powered electronic keypad with reprogrammable manager and owner codes that override access. Three consecutive incorrect code entries shall disable lock for three minutes.

1. Designed for shared or temporary access by multiple users, with user-defined code to lock and unlock. Provide LED indicator to show when lock is in use.

B. Frameless Hinges (European Type): Fully concealed, nickel-plated steel, with not less than 110 degrees of opening.

1. Provide two hinges for doors 36 inches high and less.
2. Provide three hinges for doors more than 36 inches high.

C. Accessible Handle: Metal, fixed, graspable lever handle and rose trim; surface mounted.

D. Hooks: Manufacturer's standard, ball-pointed aluminum or steel; chrome finished. Attach hooks with at least two fasteners.

1. Provide one double-prong ceiling hook for each compartment of interlocking lockers.

E. Coat Rods: 1-inch- diameter steel; chrome finished.

1. Provide coat rod for each compartment of interlocking lockers.

2.5 ACCESSORIES

A. Number Identification Plates: Nominal 1-1/2-inch- round or square with rounded corners, etched, embossed, or stamped, polished chrome plates with black numbers and letters at least 1/2 inch high. Identify lockers in sequence indicated on Drawings.

2.6 BENCHES

A. Pedestal-Leg Locker Benches: Bench top supported by pedestal legs, minimum of two pedestals for each bench, with overall height of 18 inches measured from top of bench to floor, as follows:

1. Metal Pedestal Legs: 1-1/2-inch- diameter, stainless-steel round tube or pipe.
2. Bench Tops: 1-1/4 inches deep; fabricated as follows:

    a. Butcher Block Top: Solid laminated hardwood.
    b. Width: 15 inches except provide minimum 20-inch width where accessible benches are indicated.
    c. Length: As indicated.

3. Bench Backs: Back support for full width of bench, secured to bench.

    a. Construction: Match style, material, and finish of bench top:
    b. Height: Beginning at a point no more than 2 inches above the seat surface to a height no less than 18 inches above the seat surface.

2.7 FABRICATION

A. Fabricate each locker with shelves, an individual door and frame, an individual top, a bottom, and a back, and with common intermediate uprights separating compartments.

1. Fabricate lockers to dimensions, profiles, and details indicated.
2. Ease edges of corners of solid-wood members to 1/16-inch radius.

B. Fabricate lockers square, rigid, without warp, and with finished faces flat and free of dents, scratches, and chips. Accurately factory machine components for attachments. Make joints tight and true.

1. Fabricate lockers using manufacturer's standard construction, with joints made with dowels, dados, or rabbets. Dado side panels to receive shelving except where indicated to be adjustable.

C. Accessible Lockers: Fabricate as follows:

1. Locate bottom shelf no lower than 15 inches above the floor.
2. Where hooks, coat rods, or additional shelves are provided, locate no higher than 48 inches above the floor.

D. Venting: Fabricate lockers with space between doors and locker assembly of not less than 1/4 inch.

E. Number Identification Plates: Inlay number plates flush in each locker door, near top, centered.

F. Complete fabrication, including assembly, finishing, and hardware application, to maximum extent possible, before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.

1. Use only manufacturer's nuts, bolts, screws, and other devices for assembly.

G. Shop cut openings, to maximum extent possible, to receive hardware, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.

H. Attach PVC edging to panels by thermally fusing edging to panels after panel fabrication.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine walls and floors or support bases, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Verify that furring is attached to concrete and masonry walls that are to receive lockers.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Condition lockers to average prevailing humidity conditions in installation areas before installation.

B. Before installing lockers, examine factory-fabricated work for completeness and complete work as required, including removal of packing.

3.3 INSTALLATION

A. Install wood support base with 1/2-inch- thick, plywood top.

B. Install lockers level, plumb, and true; use concealed shims.

C. Connect groups of lockers together with manufacturer's standard fasteners, through predrilled holes, with no exposed fasteners on face frames. Fit lockers accurately together to form flush, tight, hairline joints.

D. Install lockers without distortion so doors and drawers fit openings properly and are accurately aligned. Adjust hardware to center doors and drawers in openings, providing unencumbered operation. Complete installation of hardware and accessory items as indicated.

1. Installation Tolerance: No more than 1/8 inch in 96-inch sag, bow, or other variation from a straight line. Shim as required with concealed shims.

E. Locker Anchorage: Fasten lockers through wood locker base, at ends, and not more than 36 inches o.c. with No. 8 flush-head wood screws sized for 1-inch penetration into wood base.

F. Scribe and cut corner and filler panels to fit adjoining work using fasteners concealed where practical. Repair damaged finish at cuts.

G. Fixed Locker Benches: Provide no fewer than two pedestals for each bench, uniformly spaced not more than 72 inches apart. Securely fasten tops of pedestals to undersides of bench tops, and anchor bases to floor.

3.4 ADJUSTING

A. Clean, lubricate, and adjust hardware. Adjust doors to operate easily without binding. Verify that integral locking devices operate properly.

3.5 PROTECTION

A. Protect lockers from damage, abuse, dust, dirt, stain, or paint. Do not permit use during construction.

B. Touch up marred finishes, or replace lockers that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by locker manufacturer.

END OF SECTION

SECTION 10 56 26 - MOBILE STORAGE SHELVING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Mechanically assisted systems.
2. Steel four-post shelving.

B. Products Furnished But Not Installed Under This Section:

1. Inserts in cast-in-place concrete.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include mobile operation, construction details, material descriptions, dimensions of individual components and profiles, and finishes for mobile storage shelving systems and accessories.

B. Sustainable Design Submittals:

1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.
2. Composite Wood Products: Verify products are made using ultra-low-emitting formaldehyde resins, as defined in the California Air Resources Board's "Airborne Toxic Control Measure to Reduce Formaldehyde Emissions from Composite Wood Products," or are made with no added formaldehyde.

C. Shop Drawings:

1. Include plans, elevations, sections, and details.
2. Show shelving layout.
3. Show location and extent of rail system.
4. Show clear-aisle widths from face of carriages.
5. Detail fabrication and installation of mobile shelving systems including methods of anchoring shelves to carriages and rails to building structure.

D. Samples: For each exposed product and for each color and texture specified, 6 inches in size.

E. Samples for Verification: For the following products, one of each, in manufacturer's standard size:

1. Flat shelving.
2. Front panels.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer and manufacturer.

B. Sample Warranty: For manufacturer's special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For mobile shelving systems and operating manuals to include in maintenance manuals.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: A manufacturer capable of fabricating mobile storage shelving that meets or exceeds performance requirements indicated and of documenting this performance by test reports, and calculations.

B. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

1.7 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of support rail anchors, depressed slab, embedded conduit, and other construction contiguous with mobile storage shelving by field measurements before fabrication.

1.8 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of mobile shelving systems that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Deterioration of metals, metal finishes, and other materials beyond normal wear.

2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain mobile storage systems including shelving from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide mobile shelving systems capable of supporting the following:

1. Load per Linear Foot of Carriage: 1500 lb/ft..

B. Operating Force: For manually operated systems, maximum 1 lbf required to move 1000 lb.

2.3 SYSTEMS AND COMPONENTS

A. General: Provide manufacturer's standard mobile storage shelving systems and components. Where components are not otherwise indicated, provide manufacturer's standard components as required for a complete system.

B. Recycled Content of Steel Products: Provide products with postconsumer recycled content plus one-half of preconsumer recycled content to the extent required to comply with the minimum criteria specified in Section 01 81 13.14 “Sustainable Design Requirements.”

C. Inserts: Furnish required concrete inserts and similar anchorage devices for installing track system, and furnish other components of work where installation of devices is specified in another Section.

D. Flooring: Underlayment thickness required to bring aisle floor finish flush with rail tops.

1. Composite Wood Products: Verify products are made using ultra-low-emitting formaldehyde resins, as defined in the California Air Resources Board's "Airborne Toxic Control Measure to Reduce Formaldehyde Emissions from Composite Wood Products," or are made with no added formaldehyde.
2. Plywood Underlayment: DOC PS 1, Interior, Underlayment.

a. Fire-Retardant-Treated Plywood by Pressure Process: Products with a flame-spread index of 25 or less when tested according to ASTM E84.

3. Ramps: Manufacturer's standard metallic-coated, cold-rolled steel ramp not steeper than 1:12, with non-slip finish.
4. Floor Finish: To match adjacent floor finish.

E. Tracks: Steel rails with tops machined to mate with guide wheels and with ends designed to provide smooth, secure continuity between sections without field welding. Provide mounting brackets, anchorage devices, adjustable leveling devices, and stops at terminations of rails to prevent carriages from running off track ends.

1. Mounting: Surface mounted.

F. Carriages: Rigid frames consisting of C-shaped cold-formed steel beams and cross beams, designed to allow secure anchorage of shelving units.

1. Carriage Width: As indicated.
2. Carriage Length: As indicated.
3. Wheels: Manufacturer's standard number of bearing-mounted, steel wheels, precision ground to mate with tracks.
4. Bumpers: Provide two rubber bumpers with minimum depth of 1/2 inch each side.

G. Carriage End Panels: Full depth and height of shelving units. Provide at both ends of each range.

1. Material: Cold-rolled steel sheet, 0.048 inch thick with wood veneered decorative end panel with solid wood edge trims.

2.4 MECHANICALLY ASSISTED SYSTEMS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Ames Color File.
2. ASRS of America.
3. Aurora Storage Products, Inc.
4. Borroughs Corporation.
5. Datum Filing Systems, Inc.
6. Jeter Systems.
7. Kardex Systems, Inc.
8. Montel Inc.
9. Southwest Solutions.
10. Spacenow! Corporation.
11. Spacesaver Corporation.
12. Tab US.

B. Drive Systems: Geared transmission and chain systems with tensioning device to provide mechanical assistance and uniform movement along entire length of each carriage. Permanently shielded and lubricated.

C. Drive Shaft: Continuous tubular or solid steel shaft, capable of transmitting torque from drive system without distortion.

D. Locking Pins: Located on range end panels to allow locking of individual range carriage when depressed.

2.5 STEEL FOUR-POST SHELVING

A. Steel Four-Post Shelving: Shelving consisting of four angle-iron uprights per section, with adjustable shelves resting on shelf supports hung on uprights. Configure units for mounting on mobile carriages.

B. Shelving Units:

1. Type: Self-supporting and Adder unit.
2. Configuration: Closed back and ends.
3. Width: As indicated.
4. Height: As indicated.
5. Shelf Depth: As indicated.
6. Shelf Styles: Provide the following styles and numbers of adjustable shelves:

    a. Flat; five shelves.
    b. Adjustable divider: Provide five adjustable partitions per shelf with hooks or tabs to fit in slots in divider shelves.

C. Uprights: Double-wall steel posts, 2 inches wide, 0.048 inch thick, in manufacturer's standard T-shape for common-post use or L-shape at range ends, with keyhole perforations on the inner wall at 1-1/2 inches o.c.

D. Steel Spacers: Provide 0.048-inch-thick steel spacers, 3 inches high, welded to posts at bottom, center, and top of open units to prevent deflection.

E. Closed Back and Ends: 0.024-inch-thick cold-rolled steel sheet.

F. Center Divider: 0.024-inch-thick cold-rolled steel sheets.

G. Base: Manufacturer's standard for attachment to mobile carriages.

H. Adjustable Steel Shelves: 0.030-inch-thick cold-rolled steel sheet.

1. Shelf Supports: Full-shelf-width supports; 0.075-inch-thick steel, minimum 3/4 inches high, with flange to support shelf reinforcements and with ear at each end containing two shoulder rivets with 7/16-inch heads spaced to set into keyhole slots on uprights.
2. Shelf Reinforcements: Channel shapes equal in length to depth of the supported shelf; 0.060-inch-thick steel channels, with notched ends to fit over inside lip of shelf support.

2.6 MATERIALS

A. Wood Veneer: Veneer of species indicated, with Grade A faces.

1. Veneer Species and Cut: As preselected and indicated in Finish Schedule.

2.7 STEEL FINISHES

A. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

B. Baked-Enamel or Powder-Coat Finish: Manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat to achieve a minimum dry film thickness of 2 mils.

1. Color and Gloss: As selected by Architect from manufacturer's full range.

2.8 SYSTEM ACCESSORIES

A. Floor Lock: Key-operated floor lock capable of securing entire system. Provide two keys.

B. Aisle Lights: Manufacturer's standard aisle lighting system that automatically turns on when aisle is open and shuts off when aisle is closed. Provide two light unit per aisle.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, with Installer present, for compliance with requirements for installation tolerances, location of framing and reinforcements, and other conditions affecting performance of mobile shelving systems.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Level and plumb tracks to a tolerance of 0.09 inch in 120 inches with no more than 0.06-inch variation between adjacent rails. Use permanent shims or non-shrink grout as indicated by manufacturer.

B. Surface-Mounted Track Systems: Install underlayment, ramps, and finish flooring according to manufacturer's written instructions and flush with track surfaces. Do not extend ramps beyond ends of carriages.

C. Carriage Installation: Mount mobile carriages on track system with anti-tip brackets engaged by rails and adjust for smooth operation. Provide non-moving carriages securely fixed to rails where indicated.

3.3 SHELVING INSTALLATION

A. Attach shelving units to carriages according to manufacturer's written instructions and as required to prevent vibration during movement.

1. Level and plumb shelving units to a tolerance of 1/8 inch in 96 inches.

B. Starter/Adder Units: Connect groups together with standard fasteners according to manufacturer's written instructions, using concealed fasteners where possible.

C. Install shelves in shelving units at locations indicated on Drawings and according to manufacturer's written instructions.

D. Shelving Enclosure Panels: Install end panels with concealed fasteners.

3.4 CLEANING AND PROTECTING

A. Repair or remove and replace defective work as directed on completion of installation.

B. Clean finished surfaces, touch up as required, and remove or refinish damaged or soiled areas to match original factory finish, as approved by Architect.

C. Protect installed products from damage during remainder of the construction period.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain mobile storage shelving.

END OF SECTION

This page is intentionally left blank.

SECTION 10 81 13 - BIRD CONTROL DEVICES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Wire bird deterrent system. Provide a complete system to deter birds from alighting or roosting anywhere on the designated areas.

1.2 ACTION SUBMITTALS

A. Product Data: For bird control devices.

B. Shop Drawings: Plan showing complete system layout including details showing mounting and fastener locations.

C. Samples: 12-inch-long indicating color and finishes.

1.3 INFORMATIONAL SUBMITTALS

A. Manufacturer’s installation instructions.

B. Qualification Data: For Manufacturer and installer.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: Minimum 5 years’ experience in manufacturing bird deterrent system devices.

B. Installer Qualifications: Approved and trained by manufacturer for proper installation of bird deterrent system devices specified.

C. Mockup: Build mockup to verify selections made under Sample submittals, to demonstrate aesthetic effect, and to set quality standards for material and executions.

1. Size: 10 lineal feet in location approved by Architect.
2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURER

A. Source Limitations: Obtain all components for bird control devices as a complete package from a single manufacturer.

2.2 BIRD CONTROL DEVICES

A. Bird Deterrent System: A spring-tensioned post and wire system designed to create an unstable landing area that discourages pest birds from landing and roosting.

B. Basis-of-Design Product: Subject to compliance with requirement, provide **Bird Barrier America, Inc.; Birdwire** or comparable product by one of the following:

1. Bird-X.
2. Nixalite of America, Inc.

C. Components:

1. Wire: High tensile strength, alloy 316, stainless steel wire; 0.030 inch diameter.
2. Rods: Manufacturer's standard alloy 316 stainless steel in manufacturer's standard height as recommended by manufacturer for effectiveness and as approved on Shop Drawings.

D. Attachment: Secure wire to posts with stainless steel springs. Secure posts to substrate with manufacturer's recommended mechanical attachment for substrate indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine supporting structure and conditions under which Work will be installed.

B. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean surfaces to receive bird control devices thoroughly as recommended by manufacturer.

B. Ensure surfaces are clean, dry, and free from obstructions before installation of bird control devices.

3.3 INSTALLATION

A. Install bird control devices according to manufacturer's written installation instructions and approved Shop Drawings to fully cover surface requiring protection.

B. Install wire in lengths not to exceed 10 feet. Provide a spring and termination for each 10 foot wire section.

3.4 ADJUSTING AND CLEANING

A. Make adjustments needed to conform to manufacturer's installation instructions and guidelines.

B. Clean all surfaces to remove waste.

3.5 PROTECTION

A. Protect installed bird control devices until completion of Project.

END OF SECTION

This page is intentionally left blank.

SECTION 11 12 00 – VEHICLE ACCESS CONTROL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Furnish and install a complete barrier gate operator system for the bus turn-around facility. Include all necessary boards, power supplies, loop detectors, barrier arm(s), connectors, RFID windshield tags, RFID readers and accessories for a complete operational system.

1.2 REFERENCE DOCUMENTS

A. Vehicular Gate Operator shall be in compliance with Underwriters Laboratories Inc. (UL) Standard for Safety - Door, Drapery, Gate, Louver and Window Operators and Systems, UL 325 Fourth Edition; and Underwriters Laboratories Inc. (UL) Standard for Safety - Tests for Safety-Related Controls Employing Solid-State Devices, UL 991 Second Edition.

B. Vehicular Gate Operator shall be tested for compliance to UL 325 and UL 991 and shall be LISTED by a Nationally Recognized Testing Laboratory (NRTL).

1.3 SUBMITTALS

A. Product Data: Submit a complete list of equipment and materials proposed for system, with catalog cuts, technical data, manufacturer's specifications, and detail drawings.

B. Shop Drawings: Submit a complete set of detailed Shop Drawings of operating controls, instrument wiring, and schematic diagrams of circuits. Indicate plan layout of equipment, access lanes, conduit and outlet locations, power requirements and conformation to site electrical.
   1. Wiring Drawings: include diagram for power, signal and control wiring

C. Closeout Submittals:
   1. Measurement & readings obtained during systems checkout shall be recorded and included with manuals and project record documents.
   2. Submit the following documentation
      a. A single reproducible set of drawings of each system, as installed, with cable numbers designated on drawings.
      b. Test results for each system installed.
   3. Operation and service manuals, containing schematic drawings and service manuals, on all types of active and passive equipment installed.

D. Samples: Submit samples of reader, tags, and reader enclosure for review. Submit Intercom backbox

1.4 EXTRA MATERIALS

A. Gate Arms: One replacement gate arms for each gate installed. Include accessory components

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging with labels intact until ready for installation.

B. Schedule delivery of parking control equipment so that spaces are sufficiently complete that operators can be installed upon delivery.

PART 2 - PRODUCTS

2.1 AUTOMATIC BARRIER GATE OPERATOR & ARM

A. General: Provide vehicle control device consistent of operator and controller housed in weather tight tamper-resistant cabinet enclosure with gate arm. Device shall be activated by a signal from access control device.

B. Basis of Design: Gate Operator shall be model Parking-Pro with Folding Boom (Manuf: Magnetic Autocontrol).
1. Housing: Control units mounted to zinc plated sheet steel panel. All components accessible through maintenance door and removable top cover. Aluminum extruded housing frame chromatized and powder coated. Provided with one lockable service door with weather tight (IP54) enclosure. Lock is secured with a double cam to secure the hood and front access panel.
2. Colour definition: Orange
3. Gate Arm: Extruded aluminum shop finished with white powder coat and red reflective tape labels. Trim to length approved by Architect. Utilize folding boom within garage areas.
4. Flange Type: Octagon flange.
5. Drive Unit: MHTM Microdrive, 100 percent duty cycle, spring-balanced, brushless, DC servo motor and lever system. Lever system locks the barrier arm in both end positions. In case of power outage, the barrier can easily be moved by hand. Drive system provides a MTBF in excess of 2 million cycles operation. Microdrive with combined motor control and gearing tested for 10 million cycles.
6. Safety device: provide safety loop with the following device
7. The gate control shall be operable by a key box in accordance with Section 914 of the Building Code and shall be installed at the approved location for fire department access. The key box shall be of an approved type and shall contain keys to gain necessary access to the turnaround as required by the code official.

2.2 VEHICLE DETECTOR

A. Vehicle Loops
1. General: Provide solid-state electronic vehicle detector units, design to detect presence or transit of a vehicle over an embedded loop of wire and emit and electrical pulse to operate other equipment
2. Detector Loop: Provide detector loops consisting of multiple strands of wire of the gage, number of turns, size and method of installation as recommended by access control equipment manufacturer so that:
3. Gate does not close on a stalled vehicle, either entering or exiting
   a. Both gates open for an exiting vehicle, allowing a "free out". Loops shall be located to eliminate the need for breakage during the exit. Contractor to test system using University Bus design vehicles.
   b. No loop detectors required for entering vehicles, gate arm will be controlled by RFID tag and reader.

4. Install loop detector controller within barrier arm controller cabinet in accordance with manufacturer's recommendations.

B. Vehicle Presence Sensor
1. The OVS-01GT from OPTEX is designed to reliably detect the presence of a stationary or moving vehicle while also having the ability to ignore most human traffic. It also eliminates the hassle of a ground loop. No more concrete cutting required. The OVS-01GT can be mounted 2 to 3 feet off the ground and can detect both small and large vehicles. Its detection area can be customized easily, and without the need for lifts or ladders. The OVS-01GT is a versatile sensor for a variety of applications, including security gates, parking structures, banks, pharmacies, QSRs and industrial doors.

2. OVS-MP -Minipost for mounting the OVS-01GT and OVS-01CC sensors. From left to right: two 30-inch yellow Miniposts, one with an OVS-01GT, and two 30-inch black Miniposts with an OVS-01CC; two 23-inch yellow Minipost curb models with an OVS-01GT, and two 23-inch black Minipost curbs with an OVS-01CC. Select posts per Architects direction.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install equipment in accordance with manufacturer's instructions and Shop Drawings. Coordinate installation of anchors and accessories encased in concrete.

B. Gate Arm Operator: Equipment shall be mounted directly to a concrete pad, firmly secured, plumb, and level. Wiring shall be uniform and in accordance with national electric codes and manufacturer's instructions. All splices shall be in easily accessible junction boxes or on terminal boards. All cable runs in all junction boxes shall be tagged and identified. Coordinate all work with other effected trades and contractors.

C. Remove barrier-gate arms during the construction period to prevent damage and install them immediately before Substantial Completion.

3.2 EXAMINATION

A. Test the system to verify that access is granted for valid tags and denied for invalid tags.

B. Test the loop sensors to verify that the devices sense a vehicle in the exit lanes and cause the barrier arm to open.

C. Adjust control equipment to operate smoothly, easily and properly.

D. System Test: It shall be the responsibility of The Contractor to demonstrate to The Owner that the Access Control System is complete and functional.
1. The Contractor shall demonstrate the following:
   a. Control of existing Vehicle Barrier system from the Guard Booth and Main Desk
   b. Control of new Gate Controllers operator from the Guard booth and Main Control Desk.
   c. Control of the existing Vehicle Gate from the Guard Booth and Main Desk.

END OF SECTION 11 12 00

SECTION 11 13 19 - STATIONARY LOADING DOCK EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Stationary loading dock lifts (scissor lifts).

B. Related Requirements:

1. Section 05 50 00 "Metal Fabrications" for curb angles at edges of recessed pits.

1.2 DEFINITIONS

A. Operating Range: Maximum amount of travel above and below the loading dock level.

B. Working Range: Recommended amount of travel above and below the loading dock level for which loading and unloading operations can take place.

1.3 COORDINATION

A. Coordinate size and location of loading dock equipment indicated to be attached to or recessed into concrete or masonry, and furnish anchoring devices with templates, diagrams, and instructions for their installation

B. Coordinate installation of cast-in-place items. Furnish setting drawings and templates.

C. Electrical System Roughing-in: Coordinate layout and installation of loading dock equipment with connections to power supplies.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Inspect and discuss electrical roughing-in, equipment bases, and other preparatory work specified elsewhere.
2. Review required testing, inspecting, and certifying procedures.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for stationary loading dock equipment.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: For stationary loading dock equipment.

1. Include plans, elevations, sections, and attachment details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of anchors and each field connection.
3. Include diagrams for power, signal, and control wiring.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Test Reports: For each dock leveler, for tests performed by manufacturer and witnessed by a qualified testing agency.

1. Indicate compliance of dock levelers with requirements in MH 30.1 for determining rated capacity based on comprehensive testing within last two years of current products.
2. Submittal Form: According to MH 30.1.

C. Sample Warranty: For manufacturer's special warranty.

1.7 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For stationary loading dock equipment to include in operation and maintenance manuals.

1.8 QUALITY ASSURANCE

A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

1.9 FIELD CONDITIONS

A. Field Measurements: Verify actual dimensions of construction contiguous with stationary loading dock equipment, including recessed pit dimensions, by field measurements before fabrication.

1.10 WARRANTY

A. Manufacturer's Special Warranty: Manufacturer agrees to repair or replace dock levelers that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

    a. Structural failures including cracked or broken structural support members, load-bearing welds, and front and rear hinges.
    b. Faulty operation of operators, control system, or hardware.
    c. Deck plate failures including cracked plate or permanent deformation in excess of 1/4 inch between deck supports.
    d. Hydraulic system failures including failure of hydraulic seals and cylinders.

2. Warranty Period for Structural Assembly: 10 years from date of Substantial Completion.
3. Warranty Period for Hydraulic System: Five years from date of Substantial Completion.
4. Warranty shall be for unlimited usage of leveler for the specified rated capacity over the term of the warranty.

PART 2 - PRODUCTS

2.1 STATIONARY LOADING DOCK LIFTS

A. General: Stationary, scissors-type, single-leg, hydraulic dock lift of capacity, size, and construction indicated; complete with controls, safety devices, and accessories required.

1. Basis-of-Design Product: Subject to compliance with requirements, provide **Blue Giant Equipment Corporation; Lomaster Dock Lift Model DL Stationary** or a comparable product by one of the following:

    a. Kelley; Entrematic; ASSA ABLOY.
    b. Pentalift Equipment Corporation.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Standard: MH 29.1.

D. Rated Capacity: Lifting capacity of not less than 10000 lb with axle loads of 8000 lb at ends and 5000 lb at sides.

E. Platform: Nonskid, safety-tread heavy hot-dip galvanized- steel deck plate.

1. Platform Size: 96 inches long by 72 inches wide.
2. Platform Guarding: Bevel toe guards to comply with requirements in MH 29.1.
3. Removable Guard Rails: Provide steel hot-dip galvanized-steel guard rails on two sides of platform with a single, removable chain across each end. Provide guard rails not less than 39 inches high with midrail and 4-inch-high, kick plate at bottom. Mount rail sockets flush with platform surface.

F. Bridge: Nonskid, safety-tread steel plate.

1. Hinged Bridge: Hinged, throw-over bridge bolted to full-length, heavy-duty, piano-type hinge welded to toe guard at end of platform. Provide bridge complete with heavy-duty lifting chains. Chamfer edge of bridge to minimize obstructing wheels of material-handling vehicles.

2. Size: 18 inches long by 60 inches wide.
3. Locations: Ends.

G. Function: Dock lifts shall compensate for differences in height between truck bed and loading platform.
1. Vertical Travel: Maximum of 59 inches from a lowered height of 14 inches for a total raised height of 73 inches.
2. Lift Time: 57 seconds; nominal with rated load.

H. Hydraulic Operating System: Self-contained, electric, hydraulic power unit for raising and lowering lift; of size, type, and operation needed for capacity of lift indicated; controlled from a remotely located push-button station.

1. Power Unit: Consisting of continuous-duty motor, high-pressure gear pump, valve manifold, oil-line filters, and oil reservoir.

a. Equip manifold with relief valve, check valve, pressure-compensated flow-control valve, and solenoid valve and with provisions for lowering lift manually if power fails.
b. Equip reservoir, valve manifold, and pressure line with oil-line filters.

2. Cylinders: Equip lift with not less than two heavy-duty, high-pressure, hydraulic, ram-type cylinders. Rams shall be manufacturer's standard, either direct-displacement-plunger or rod-and-piston type with positive internal stops. Cylinder rods shall be chrome plated and polished.

a. Rate of Descent Protection: Pressure-compensated flow control or hydraulic velocity fuse to limit down speed for each cylinder.

3. Remote-Control Station: Multibutton control station of the constant-pressure type with UP and DOWN push buttons. Controller shall consist of magnetic motor starter with three-pole adjustable overloads and 24-V control transformer with 4-A, fused secondary prewired to terminal strips and enclosed in NEMA ICS 6, Type 12 box.

a. Upper-Travel-Limit Switch: Equip unit with manufacturer's standard, adjustable, upper-travel-limit switch.

I. Construction: Fabricate lift from structural-steel shapes rigidly welded and reinforced for maximum strength, safety, and stability. Design assembly to withstand deformation during both operating and stored phases of service. Provide mounting brackets and removable lifting eyes for ease of installation.

1. Scissors Mechanism: Fabricate leg members from heavy, hot-dip galvanized- steel-formed tube or plate members to provide maximum strength and rigidity.
2. Scissors Configuration: Single leg.
3. Bearings: Pivot points with permanently lubricated antifriction bushings or sealed ball-bearings for minimum maintenance.
4. Maintenance Leg: Removable, safety maintenance leg or hinged, safety maintenance bars.
5. Mounting: Pit.

J. Materials:

1. Steel Plates, Shapes, and Bars: ASTM A36/A36M.
2. Rolled-Steel Floor Plate: ASTM A786/A786M, rolled from steel plate complying with ASTM A572/A572M, Grade 55.
3. Steel Tubing: ASTM A500/A500M, cold formed.

K. Dock Lift Finish: Manufacturer's standard baked-on factory finish unless otherwise indicated.

2.2 FINISH REQUIREMENTS

A. Finish loading dock equipment after assembly and testing.

B. Hot-Dip Galvanizing: Comply with the following:

1. ASTM A123/A123M for iron and steel loading dock equipment.
2. ASTM A153/A153M or ASTM F2329/F2329M for iron and steel hardware for loading dock equipment.

C. Baked-on Factory Finish: Clean, pretreat, and apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.

1. Color: Manufacturer's standard.
2. Toe Guards: Paint to comply with ANSI Z535.1.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for electrical systems for loading dock equipment to verify actual locations of connections before equipment installation.

C. Examine walls and floors of pits for suitable conditions where recessed loading dock equipment is to be installed. Pits shall be plumb and square and properly sloped for drainage from back to front of loading dock.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Set curb angles in concrete edges of dock-leveler recessed pits with tops flush with loading platform. Fit exposed connections together to form hairline joints.

B. Set curb angles in concrete edges of truck-leveler recessed pits with tops flush with driveway. Fit exposed connections together to form hairline joints.

C. Clean recessed pits of debris.

3.3 INSTALLATION, GENERAL

A. Install loading dock equipment as required for a complete installation.

1. Rough-in electrical connections.

3.4 INSTALLATION OF STATIONARY LOADING DOCK LIFTS

A. Attach dock lifts securely to floor of recessed pit.

3.5 ADJUSTING

A. Adjust loading dock equipment to function smoothly and safely, and lubricate as recommended by manufacturer.

B. Test dock levelers for vertical travel and adjust to maintain operating range indicated.

C. After completing installation of exposed, factory-finished loading dock equipment, inspect exposed finishes and repair damaged finishes.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain loading dock equipment.

END OF SECTION

SECTION 11 19 16 - DETENTION GUN LOCKERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Pistol lockers.

1.2 COORDINATION

A. Coordinate installation of anchorages for detention gun lockers. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors that are to be embedded in adjacent construction. Deliver such items to Project site in time for installation.

B. Coordinate size and location of recesses in wall construction to receive recessed detention gun lockers.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for detention gun lockers.

B. Sustainable Design Submittals:

1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.

C. Shop Drawings: For detention gun lockers.

1. Include plans, elevations, sections, and attachment details.
2. Indicate locations, dimensions, and profiles of wall and floor reinforcements.
3. Indicate locations and installation details of built-in anchors.
4. Show elevations and indicate dimensions of detention gun lockers, preparations for receiving anchors, and locations of anchorage.
5. Show details of attachment of detention gun lockers to built-in anchors.

D. Samples for Initial Selection: For detention gun lockers with factory-applied color finishes.

1.5 INFORMATIONAL SUBMITTALS

A. Examination reports documenting inspections of substrates, areas, and conditions.

B. Anchor inspection reports documenting inspections of built-in and cast-in anchors.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Recycled Content of Steel Products: Provide products with postconsumer recycled content plus one-half of preconsumer recycled content to the extent required to comply with the minimum criteria specified in Section 01 81 13.14 “Sustainable Design Requirements.”

2.2 PISTOL LOCKERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide **Southern Folger Detention Equipment Company; 600 Pistol Locker** or a comparable product by one of the following:

1. Detention Device Systems (DDS); DDS Group.
2. Maximum Security Products Corp.
3. Tiffin Metal Products Co.

B. Cabinet: Minimum 20 inches wide by 15 inches high by 10 inches deep; formed from 0.134-inch nominal-thickness steel sheet. Line each compartment with mothproofed felt or nonabsorbing, closed-cell padding.

1. Compartments: Number as indicated on Drawings.
2. Compartment Size: 5-1/4-inch-high by 10-inch-deep by 10-inch-wide.

C. Doors: Formed from 0.180-inch nominal-thickness steel sheet, supported by heavy-duty continuous bottom hinge.

D. Locks: Cylinder type, keyed differently and master keyed; provide one lock for each compartment.

E. Mounting: As indicated on Drawings.

F. Materials:

1. Steel Plates, Shapes, and Bars: ASTM A36/A36M.
2. Cold-Rolled Steel Sheet: ASTM A1008/A1008M, CS (Commercial Steel), Type B; suitable for exposed applications.
3. Hot-Rolled Steel Sheet: ASTM A1011/A1011M, CS (Commercial Steel), Type B; free of scale, pitting, or surface defects; pickled and oiled.

G. Finishes:

1. Steel Baked-Enamel or Powder-Coat Finish: Clean, pretreat, and apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat. Comply with coating manufacturer's written instructions for applying and baking to achieve a minimum dry film thickness of 2 mils.

    a. Color and Gloss: As selected by Architect from manufacturer's full range.

2.3 FABRICATION

A. Shop Assembly: Preassemble items in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.

B. Coordinate dimensions and attachment methods of detention gun lockers with those of adjoining construction to produce integrated assemblies with closely fitting joints and with edges and surfaces aligned unless otherwise indicated.

C. Shear and punch metals cleanly and accurately. Remove burrs.

D. Form and grind edges and corners to be free of sharp edges or rough areas.

E. Form metal in maximum lengths to minimize joints. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing the Work.

F. Weld corners and seams continuously to comply with referenced AWS standard and the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. Finish exposed welds and surfaces smooth and blended at exposed connections, so that no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
5. Weld before finishing components to greatest extent possible. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.

G. Provide for anchorage of type indicated; coordinate with supporting structure. Fabricate and space anchoring devices to secure detention gun lockers rigidly in place and to support expected loads. Build in straps, plates, and brackets as needed to support and anchor fabricated items to adjoining construction. Reinforce formed-metal units as needed to attach and support other construction.

H. Cut, reinforce, drill, and tap detention gun lockers as indicated to receive hardware, fasteners, and similar items.

I. Form exposed work true to line and level with accurate angles, surfaces, and straight sharp edges.

J. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible. Locate joints where least conspicuous.

2.4 ACCESSORIES

A. Concealed Bolts: ASTM A307, Grade A unless otherwise indicated.

B. Embedded Plate Anchors: Fabricated from mild steel shapes and plates, minimum 3/16 inch thick; with minimum 1/2-inch-diameter, headed studs welded to back of plate.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of detention gun lockers.

B. Examine roughing-in for embedded and built-in anchors to verify actual locations of detention gun lockers before detention gun locker installation.

C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of detention gun lockers.

D. Verify locations of detention gun lockers with those indicated on Shop Drawings.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing detention gun lockers to in-place construction. Include threaded fasteners other connectors.

B. Cutting, Fitting, and Placement: Obtain manufacturer's written approval for cutting, drilling, and fitting required for installing detention gun lockers. Set detention gun lockers accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.

C. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations.

D. Adjust doors and latches of detention gun lockers to operate easily without binding. Verify that integral locking devices operate properly.

E. Assemble detention gun lockers requiring field assembly with security fasteners with no exposed fasteners on exposed faces and frames.

3.3 FIELD QUALITY CONTROL

A. Inspect installed products to verify compliance with requirements. Prepare inspection reports and indicate compliance with and deviations from the Contract Documents.

B. Remove and replace detention work if inspections indicate that work does not comply with specified requirements. Remove malfunctioning units; replace with new units.

C. Perform additional inspections to determine compliance of replaced or additional work. Prepare inspection reports.

D. Prepare field quality-control certification that states installed products and their installation comply with requirements in the Contract Documents.

END OF SECTION

This page is intentionally left blank.

SECTION 11 30 13 - RESIDENTIAL APPLIANCES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Cooking appliances.
2. Refrigeration appliances.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include installation details, material descriptions, dimensions of individual components, and finishes for each appliance.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished accessories.

B. Sustainable Design Submittals:

1. ENERGY STAR: Product Data for indicated products, showing compliance with requirements for ENERGY STAR product labeling.

C. Samples: For each exposed product and for each color and texture specified, in manufacturer's standard size.

1.3 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of appliance.

B. Sample Warranties: For manufacturers' special warranties.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For each residential appliance to include in operation and maintenance manuals.

1.5 WARRANTY

A. Special Warranties: Manufacturer agrees to repair or replace residential appliances or components that fail in materials or workmanship within specified warranty period.

B. Microwave Oven: Full warranty, including parts and labor, for on-site service on the magnetron tube.

1. Warranty Period: Two years from date of Substantial Completion.

C. Refrigerator/Freezer, Sealed System: Full warranty, including parts and labor, for on-site service on the product.

1. Warranty Period for Sealed Refrigeration System: Two years from date of Substantial Completion.
2. Warranty Period for Other Components: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain residential appliances from single source.

2.2 PERFORMANCE REQUIREMENTS

A. Electrical Appliances: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Accessibility: Where residential appliances are indicated to comply with accessibility requirements, comply with applicable provisions in the DOJ's 2010 ADA Standards for Accessible Design and ICC A117.1.

2.3 MICROWAVE OVENS

A. Built-in Microwave Oven with Trim Kit, EQ-4a:

1. Basis-of-Design Product: Subject to compliance with requirements, provide **Frigidaire; PMBS3080AF + PMTK3080AF** or a comparable product by one of the following:

a. Amana; Whirlpool Corporation.
b. GE Appliances.
c. KitchenAid; Whirlpool Corporation.
d. LG Electronics USA, Inc.; LG Electronics Inc.
e. Whirlpool Corporation.

2. Mounting: Built in with trim kit.
3. Type: Conventional.
4. Dimensions:

a. Width: 24-3/8 inches.
b. Depth: 19-5/8 inches.
c. Height: 13-5/8 inches.

5. Capacity: 2.2 cu. ft..
6. Oven Door: Swing door with observation window.
7. Exhaust Fan: Two-speed fan, nonvented, recirculating type with charcoal filter and with 300-cfm capacity.
8. Microwave Power Rating: 1100 W.
9. Electric Power Supply: 120 V, 60 Hz, 1 phase, 15 A.
10. Controls: Digital panel controls and timer display.
11. Other Features: Turntable and sensor cooking.
12. Material: Fingerprint resistant stainless steel.

B. Countertop Microwave Oven, EQ-4b:

1. Basis-of-Design Product: Subject to compliance with requirements, provide **GE Appliances; JESP113PSS** or a comparable product by one of the following:

    a. Amana; Whirlpool Corporation.
    b. KitchenAid; Whirlpool Corporation.
    c. LG Electronics USA, Inc.; LG Electronics Inc.
    d. Whirlpool Corporation.

2. Mounting: Countertop.
3. Type: Conventional.
4. Dimensions:

    a. Width: 20-5/16 inches.
    b. Depth: 15-5/8 inches.
    c. Height: 12 inches.

5. Capacity: 1.1 cu. ft..
6. Oven Door: Swing door with observation window.
7. Exhaust Fan: Two-speed fan, nonvented, recirculating type with charcoal filter and with 300-cfm capacity.
8. Microwave Power Rating: 950 W.
9. Electric Power Supply: 120 V, 60 Hz, 1 phase, 15 A.
10. Controls: Digital panel controls and timer display.
11. Other Features: Turntable and sensor cooking.
12. Material: Fingerprint resistant stainless steel.

2.4 REFRIGERATOR/FREEZERS

A. Refrigerator/Freezer, EQ-6a: Two-door refrigerator/freezer with freezer on bottom and complying with AHAM HRF-1.

1. Basis-of-Design Product: Subject to compliance with requirements, provide **General Electric; Model #GWE23GYNFS** or a comparable product by one of the following:

    a. Amana; Whirlpool Corporation.
    b. Frigidaire.
    c. LG Electronics USA, Inc.; LG Electronics Inc.
    d. Whirlpool Corporation.

2. Type: Freestanding.

3. Dimensions:

    a. Width: 36 inches nominal.
    b. Depth: 31-1/4 inches nominal.
    c. Height: 70 inches nominal.

4. Storage Capacity:

    a. Refrigeration Compartment Volume: 15.93 cu. ft..
    b. Freezer Volume: 7.16 cu. ft..
    c. Shelf Area: Four split adjustable and 1 full-width glass shelves.

5. General Features:

    a. Door Configuration: Overlay.
    b. Dual refrigeration systems.
    c. Separate touch-pad temperature controls for each compartment.

6. Refrigerator Features:

    a. Interior light in refrigeration compartment.
    b. Compartment Storage: Vegetable crisper and meat compartment.
    c. Door Storage: Gallon-milk-container storage.

7. Freezer Features: Two freezer compartment(s) configured as pull-out drawer(s).

    a. Automatic defrost.
    b. Interior light in freezer compartment.
    c. Automatic icemaker and storage bin.

8. ENERGY STAR: Provide appliances that qualify for the EPA/DOE ENERGY STAR product-labeling program.
9. Front Panel(s): Stainless steel.

B. Refrigerator/Freezer, EQ-6b: Two-door refrigerator/freezer with freezer on top and complying with AHAM HRF-1.

1. Basis-of-Design Product: Subject to compliance with requirements, provide **General Electric; Model #GIE17GSNRSS** or a comparable product by one of the following:

    a. Amana; Whirlpool Corporation.
    b. Frigidaire.
    c. LG Electronics USA, Inc.; LG Electronics Inc.
    d. Whirlpool Corporation.

2. Type: Freestanding.
3. Dimensions:

    a. Width: 28 inches nominal.
    b. Depth: 32-5/8 inches nominal.
    c. Height: 64-3/4 inches nominal.

4. Storage Capacity:

a. Refrigeration Compartment Volume: 12.6 cu. ft..
b. Freezer Volume: 4.04 cu. ft..
c. Shelf Area: Two adjustable glass shelves, 1 glass drawer cover,

5. General Features:

a. Door Configuration: Overlay with smooth rounded corners.

6. Refrigerator Features:

a. Interior light in refrigeration compartment.
b. Compartment Storage: Vegetable crisper and meat compartment.
c. Door Storage: Modular compartments, gallon-milk-container storage.

7. Freezer Features: One freezer compartment(s) with door.

a. Automatic defrost.
b. Interior light in freezer compartment.
c. Automatic icemaker and storage bin.

8. ENERGY STAR: Provide appliances that qualify for the EPA/DOE ENERGY STAR product-labeling program.
9. Front Panel(s): Stainless steel.
10. Appliance Color/Finish: Stainless steel.

C. Refrigerator. EQ-6c: ADA compliant, one-door refrigerator and complying with AHAM HRF-1.

1. Basis-of-Design Product: Subject to compliance with requirements, provide **Summit; AL54** or a comparable product by one of the following:

a. GE Appliances; Haier Group.
b. KitchenAid; Whirlpool Corporation.
c. LG Electronics USA, Inc.; LG Electronics Inc.
d. Whirlpool Corporation.

2. Type: Undercounter.
3. Dimensions:

a. Width: 23.63 inches nominal.
b. Depth: 22.63 inches nominal.
c. Height: 32 inches nominal.

4. Capacity: 4.8 cu. ft..
5. General Features:

a. Door Configuration: Overlay with handle.

6. Features:

a. Shelf type: Glass.
b. Shelf Quantity: 3.
c. Full Door Shelf Quantity: 2.
d. Thermostat Type: Digital.

e. Refrigerant Type: R600a.
f. Interior light.
g. Temperature Range: 36 to 43-deg-F.

7. Appliance Color/Finish: Stainless steel.

2.5 GENERAL FINISH REQUIREMENTS

A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, power connections, and other conditions affecting installation and performance of residential appliances.

B. Examine roughing-in for piping systems to verify actual locations of piping connections before appliance installation.

C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install appliances according to manufacturer's written instructions.

B. Built-in Equipment: Securely anchor units to supporting cabinets or countertops with concealed fasteners. Verify that clearances are adequate for proper functioning and that rough openings are completely concealed.

C. Freestanding Equipment: Place units in final locations after finishes have been completed in each area. Verify that clearances are adequate to properly operate equipment.

END OF SECTION

SECTION 11 81 31 - FACILITY FALL PROTECTION AND FAÇADE ACCESS EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:

1. Roof-mounted fall protection anchors.
2. Wall-mounted fall protection anchors.
3. Rigging Sleeves.
4. Horizontal lifeline system.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for fall protection anchors.

B. Shop Drawings:

1. Include plans, sections, and attachment details.
2. Indicate all loads imposed on the building structure.

C. Delegated-Design Submittal: For fall protection anchors.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Structural steel roof member sizes and locations.
2. Existing structure.
3. Cast-in-place concrete walls.

B. Qualification Data: For Installer and manufacturer.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Minimum 10 years' experience manufacturing products similar to those specified.

B. Installer Qualifications: An entity that employs trained installers and supervisors with a minimum of 10 years installing similar products.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Pro-Bel Enterprises Limited.
2. Tractel Limited, Swingstage Division.
3. Spider Staging Corporation.

2.2 PERFORMANCE REQUIREMENTS

A. Anchorage Design Requirements: Comply with all applicable OSHA and ANSI/IWCA regulations pertaining to fall protection and suspended maintenance equipment including, but not limited to, load resistance, anchor locations and spacing.

B. Structural Design Requirements: Capable of resisting the loads required by applicable standards and codes but not less than the following:

1. Design roof and wall anchors to comply with the following:

a. Capable of sustaining a minimum ultimate load of 5000 lbs., in any direction the load may be applied, without fracture or failure.
b. Capable of sustaining a fall arresting force of 1800 lbs. with a factor of safety of 2, in any direction the load may be applied, without permanent deformation or damage to anchorage.

C. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design fall protection and suspended maintenance equipment anchors and monorail system.

1. Confirm that primary structure supporting fall protection anchors is capable of resisting loads imparted by the anchors.
2. Design and detail all additional structure such as beams, kickers, and connections necessary to transfer fall protection loads from anchors to primary structure.

2.3 FALL PROTECTION ANCHORS

A. Roof Anchors: Tie-back anchors fabricated of minimum 3/4-inch diameter, Type 316 stainless steel safety U-bar with 1-1/2 inch eye opening welded to minimum 4 inch diameter stainless steel HSS section and mild steel base plate; fill HSS section with molded urethane insulation.

1. Anchor Height: Minimum 8 inch above roof surface.
2. Securement Type: Welded to steel structure, epoxy adhesive bolts, or through-bolted as required by location and substrate deck type.

B. Plaza Deck Roof Anchors: Tie-back anchors fabricated of minimum 3/4-inch diameter, Type 316 stainless steel safety U-bar with 1-1/2 inch eye opening welded to minimum 4 inch diameter stainless steel HSS section and mild steel base plate; fill HSS section with molded urethane insulation.

1. Anchor Height: As required to be concealed within plaza deck roofing assembly.
2. Securement Type: Welded to steel structure, epoxy adhesive bolts, or through-bolted as required by location and substrate deck type.

C. Wall Anchors: Tie-back anchors fabricated of minimum 3/4 inch diameter, Type 316 stainless steel safety U-bar with 1-1/2 inch eye opening welded to stainless steel HSS plate.

1. Anchor Height: Minimum 8 inch above roof surface.
2. Securement Type: Welded to embed plate or epoxy adhesive bolts as required based on substrate indicated.

2.4 RIGGING SLEEVES

A. Vertical Rigging Sleeve: Rigging sleeve fabricated of 4 inch diameter Type 316 stainless steel with detachable weatherproof cap including wing nut locking device and tether.

1. Anchor Height: Minimum 8 inch above roof surface.
2. Securement Type: Welded to top and bottom of steel wide-flange structure with steel attachment plates.

B. Portable Rigging Sleeve Head: Rigging sleeve head fabricated from Type 316 stainless steel tube of diameter to slide inside of rigging sleeve with slide plates welded to opposite sides of tube and supporting two round, stainless steel, rigging attachment bars.

2.5 HORIZONTAL LIFELINE SYSTEM

A. Non-Hands-Free (Double Lanyard) Horizontal Lifeline: Permanently installed, multi-span anchored cable serving as an attachment point for travel restraint or fall protection lanyards, including the following:

1. Lifeline Cable: ASTM A492 stainless steel, Type 316, 5/16-inch minimum diameter cable, 9127 lbs. minimum breaking strength with permanently swaged cable ends.
2. Data plate: Non-corrosive data plate stating maximum service capacity of cable, manufacturer's name, serial number, manufacturing date, rated load and other pertinent information prominently displayed at cable system entry points.
3. End supports: Roof anchor as specified above with u-bar oriented parallet to cable.
4. Intermediate supports: Roof anchor as specified above with u-bar oriented perpendicular to cable.
5. Corner units: Corner units with roller from manufacturer’s standard components to meet project requirements.
6. End terminal hardware: Stainless steel swaged termination at one end and stainless-steel tensioner with shock absorber at other end to meet project requirements.

2.6 MATERIALS

A. Steel: ASTM A 572 GR 50 and ASTM A 36 as applicable.

B. Stainless Steel: Type 316 with yield strength of 35 ksi.

C. Aluminum: ASTM B 221 (ASTM B 221M).

D. Anchor Bolts: Stainless Steel, alloy 304; ASTM A 193 Grade 8, B8.

2.7 FABRICATION

A. Fabricate work true to dimension, square, plumb, level, and free from distortion or defects detrimental to appearance and performance.

B. Grind off surplus welding material to ensure exposed surfaces are smooth and will not abrade workers' ropes.

C. Weld in accordance with the AWS Structural Welding Code D1.1/D1.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install fall protection anchors in accordance with manufacturer's recommendations and approved shop drawings.

B. Coordinate installation of fall protection roof anchors with roofing installation to ensure a watertight and warrantable condition of the roofing.

C. Coordinate installation of fall protection wall anchors with installation of exterior wall air- and weather-resistive barrier to ensure proper termination of barrier at anchor penetrations.

END OF SECTION

SECTION 11 81 33 - MOBILE SCISSOR LIFTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes mobile scissor lifts.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include material descriptions and dimensions of individual components.
2. Include rated capacities, operating characteristics, and furnished specialties and accessories.

1.1 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For mobile scissor lifts, to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 MOBILE SCISSOR LIFTS

A. General: Mobile electric, self-propelled, scissor lift, of capacity, size and construction indicated; complete with controls, safety devices, and accessories required.

1. Basis-of-Design Product: Subject to compliance with requirement, provide **Genie, a division of Terex Corporation; GS-2646 E-drive** or comparable product by one of the following:

a. JLG.
b. Skyjack.
c. Snorkel.

B. Maximum Working Height: 32 feet 1 inch.

C. Platform Capacity: 1000 lbs.

D. Machine Width: 3 feet 10 inches.

E. Machine Length: 8 feet.

F. Weight: Not greater than 4,500 lbs.

PART 3 - EXECUTION (Not Used)

END OF SECTION

SECTION 12 24 13 - ROLLER WINDOW SHADES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Manually operated, single-roller shades.
2. Motor-operated, single-roller shades.
3. Motor-operated, double-roller shades.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, features, finishes, and operating instructions for roller shades.

B. Shop Drawings: Show fabrication and installation details for roller shades, including shadeband materials, their orientation to rollers, and their seam and batten locations.

1. Motor-Operated Shades: Include details of installation and diagrams for power, signal, and control wiring.

C. Samples for Verification: For each type of roller shade.

1. Shadeband Material: Not less than 10 inches square. Mark interior face of material if applicable.
2. Roller Shade: Full-size operating unit, not less than 16 inches wide by 36 inches long for each type of roller shade indicated.
3. Installation Accessories: Full-size unit, not less than 10 inches long.

1.3 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of shadeband material.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For roller shades to include in maintenance manuals.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Roller Shades: Full-size units equal to 5 percent of quantity installed for each size, color, and shadeband material indicated, but no fewer than [**two**] <**Insert number**> units.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Fabricator of products.

B. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for fabrication and installation.

1. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver roller shades in factory packages, marked with manufacturer, product name, and location of installation using same designations indicated on Drawings.

1.8 FIELD CONDITIONS

A. Environmental Limitations: Do not install roller shades until construction and finish work in spaces, including painting, is complete and dry and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

B. Field Measurements: Where roller shades are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Allow clearances for operating hardware of operable glazed units through entire operating range. Notify Architect of installation conditions that vary from Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Obtain roller shades from single source from single manufacturer.

2.2 MANUALLY OPERATED, SINGLE-ROLLER SHADES

A. Basis-of-Design Product: Subject to compliance with requirements, provide **MechoShade Systems, LLC; Mecho/7** or a comparable product by one of the following:

1. Hunter Douglas, Inc.

2. Lutron Electronics Co., Inc.
3. Silent Gliss Inc.; Silent Gliss International Ltd.

B. Chain-and-Clutch Operating Mechanisms: With continuous-loop bead chain and clutch that stops shade movement when bead chain is released; permanently adjusted and lubricated.

1. Bead Chains: Stainless steel.

a. Loop Length: Full length of roller shade.
b. Limit Stops: Provide upper and lower ball stops.
c. Chain-Retainer Type: Clip, jamb mount.

2. Spring Lift-Assist Mechanisms: Manufacturer's standard for balancing roller shade weight and for lifting heavy roller shades.

a. Provide for shadebands that weigh more than 10 lb or for shades as recommended by manufacturer, whichever criterion is more stringent.

C. Rollers: Corrosion-resistant steel or extruded-aluminum tubes of diameters and wall thicknesses required to accommodate operating mechanisms and weights and widths of shadebands indicated without deflection. Provide with permanently lubricated drive-end assemblies and idle-end assemblies designed to facilitate removal of shadebands for service.

1. Roller Drive-End Location: As indicated and approved on Shop Drawings.
2. Direction of Shadeband Roll: Regular, from back (exterior face) of roller, unless indicated otherwise on Drawings.
3. Shadeband-to-Roller Attachment: Removable spline fitting into integral channel in tube.

D. Mounting Hardware: Brackets or endcaps, corrosion resistant and compatible with roller assembly, operating mechanism, installation accessories, and mounting location and conditions indicated.

E. Shadebands:

1. Shadeband Material: Light-filtering fabric or light-blocking fabric as indicated on Finish Schedule.
2. Shadeband Bottom (Hem) Bar: Steel or extruded aluminum.

a. Type: Enclosed in sealed pocket of shadeband material.
b. Color and Finish: As preselected and indicated in Finish Schedule.

F. Installation Accessories: As indicated on Drawings:

1. Front Fascia: Aluminum extrusion that conceals front and underside of roller and operating mechanism and attaches to roller endcaps without exposed fasteners.

a. Shape: L-shaped.
b. Height: Manufacturer's standard height required to conceal roller and shadeband assembly when shade is fully open, but not less than 4 inches.

2. Recessed Shade Pocket: Rectangular, extruded-aluminum enclosure designed for recessed ceiling installation; with front, top, and back formed as one piece, end plates, and removable bottom closure panel.

a. Height: Manufacturer's standard height required to enclose roller and shadeband assembly when shade is fully open, but not less than height indicated on Drawings.
b. Where applicable, provide pocket with lip at lower edge to support acoustical ceiling panel.

3. Closure Panel and Wall Clip: Removable aluminum panel designed for installation at bottom of site-constructed ceiling recess or pocket and for snap-in attachment to wall clip without fasteners.

a. Closure-Panel Width: 2 inches.

4. Side Channels: With light seals and designed to eliminate light gaps at sides of shades as shades are drawn down. Provide side channels with shadeband guides or other means of aligning shadebands with channels at tops.
5. Bottom (Sill) Channel or Angle: With light seals and designed to eliminate light gaps at bottoms of shades when shades are closed.
6. Installation Accessories Color and Finish: As selected from manufacturer's full range.

2.3 MOTOR-OPERATED, SINGLE-ROLLER SHADES

A. Basis-of-Design Product: Subject to compliance with requirements, provide **MechoShade Systems, LLC; Electro** or a comparable product by one of the following:

1. Hunter Douglas, Inc.
2. Lutron Electronics Co., Inc.
3. Silent Gliss Inc.; Silent Gliss International Ltd.

B. Motorized Operating System: Provide factory-assembled, shade-operator system of size and capacity and with features, characteristics, and accessories suitable for conditions indicated, complete with electric motor and factory-prewired motor controls, power disconnect switch, enclosures protecting controls and operating parts, and accessories required for reliable operation without malfunction. Include wiring from motor controls to motors. Coordinate operator wiring requirements and electrical characteristics with building electrical system.

1. Electrical Components: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Electric Motor: Manufacturer's standard tubular, enclosed in roller.

a. Electrical Characteristics: As indicated on Drawings.
b. Maximum Total Shade Width: As required to operate roller shades indicated.
c. Maximum Shade Drop: As required to operate roller shades indicated.
d. Maximum Weight Capacity: As required to operate roller shades indicated.

3. Remote Control: Electric controls with NEMA ICS 6, Type 1 enclosure for recessed or flush mounting. Provide the following for remote-control activation of shades:

a. Individual Switch Control Station: Maintained-contact, wall-switch-operated control station with open, close, and center off functions.

1) Switch Positions: Three.
2) Switch Style: Rocker.

b. Color: As selected by Architect from manufacturer's full range.

4. Limit Switches: Adjustable switches interlocked with motor controls and set to stop shades automatically at fully raised and fully lowered positions.

C. Rollers: Corrosion-resistant steel or extruded-aluminum tubes of diameters and wall thicknesses required to accommodate operating mechanisms and weights and widths of shadebands indicated without deflection. Provide with permanently lubricated drive-end assemblies and idle-end assemblies designed to facilitate removal of shadebands for service.

1. Roller Drive-End Location: As indicated and approved on Shop Drawings.
1. Direction of Shadeband Roll: Regular, from back (exterior face) of roller, unless indicated otherwise on Drawings.
2. Shadeband-to-Roller Attachment: Removable spline fitting into integral channel in tube.

D. Mounting Hardware: Brackets or endcaps, corrosion resistant and compatible with roller assembly, operating mechanism, installation accessories, and mounting location and conditions indicated.

E. Shadebands:

1. Shadeband Material: Light-filtering fabric and light-blocking fabric, as indicated on Finish Schedule.
2. Shadeband Bottom (Hem) Bar: Steel or extruded aluminum.

a. Type: Enclosed in sealed pocket of shadeband material.

F. Installation Accessories: Including the following as indicated on Drawings:

1. Front Fascia: Aluminum extrusion that conceals front and underside of roller and operating mechanism and attaches to roller endcaps without exposed fasteners.

a. Shape: L-shaped.
b. Height: Manufacturer's standard height required to conceal roller and shadeband assembly when shade is fully open, but not less than 4 inches.

2. Recessed Shade Pocket: Rectangular, extruded-aluminum enclosure designed for recessed ceiling installation; with front, top, and back formed as one piece, end plates, and removable bottom closure panel.

a. Height: Manufacturer's standard height required to enclose roller and shadeband assembly when shade is fully open, but not less than height indicated on Drawings.
b. Where applicable, provide pocket with lip at lower edge to support acoustical ceiling panel.

3. Closure Panel and Wall Clip: Removable aluminum panel designed for installation at bottom of site-constructed ceiling recess or pocket and for snap-in attachment to wall clip without fasteners.

a. Closure-Panel Width: 2 inches.

4. Side Channels: At shades with light-blocking shadeband material, provide side channels with light seals and designed to eliminate light gaps at sides of shades as shades are drawn down. Provide side channels with shadeband guides or other means of aligning shadebands with channels at tops.
5. Bottom (Sill) Channel or Angle: At shades with light-blocking shadeband material, provide bottom channel with light seals and designed to eliminate light gaps at bottoms of shades when shades are closed.
6. Installation Accessories Color and Finish: As selected from manufacturer's full range.

2.4 MOTOR-OPERATED, DOUBLE-ROLLER SHADES

A. Basis-of-Design Product: Subject to compliance with requirements, provide **MechoShade Systems, LLC; Electro** or a comparable product by one of the following:

1. Hunter Douglas, Inc.
2. Lutron Electronics Co., Inc.
3. Silent Gliss Inc.; Silent Gliss International Ltd.

B. Motorized Operating Systems: Provide factory-assembled, shade-operator systems of size and capacity and with features, characteristics, and accessories suitable for conditions indicated, complete with electric motor and factory-prewired motor controls, power disconnect switch, enclosures protecting controls and operating parts, and accessories required for reliable operation without malfunction. Include wiring from motor controls to motors. Coordinate operator wiring requirements and electrical characteristics with building electrical system.

1. Electrical Components: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Electric Motor: Manufacturer's standard tubular, enclosed in rollers.

    a. Electrical Characteristics: As indicated on Drawings.
    b. Maximum Total Shade Width: As required to operate roller shades indicated.
    c. Maximum Shade Drop: As required to operate roller shades indicated.
    d. Maximum Weight Capacity: As required to operate roller shades indicated.

3. Remote Control: Electric controls with NEMA ICS 6, Type 1 enclosure for recessed or flush mounting. Provide the following for remote-control activation of shades:

    a. Individual Switch Control Station: Maintained-contact, wall-switch-operated control station with open, close, and center off functions.

        1) Switch Positions: Three.
        2) Switch Style: Rocker.

    b. Color: As selected by Architect from manufacturer's full range.

4. Limit Switches: Adjustable switches, interlocked with motor controls and set to stop shade movement automatically at fully raised and fully lowered positions.

C. Rollers: Corrosion-resistant steel or extruded-aluminum tubes of diameters and wall thicknesses required to accommodate operating mechanisms and weights and widths of shadebands indicated without deflection. Provide with permanently lubricated drive-end assemblies and idle-end assemblies designed to facilitate removal of shades for service.

1. Double-Roller Mounting Configuration: Offset, outside shade over and inside shade under.
2. Inside Roller:

    a. Drive-End Location: As indicated and approved on Shop Drawings.
    b. Direction of Shadeband Roll: Regular, from back (exterior face) of roller unless indicated otherwise on Drawings.

3. Outside Roller:

    a. Drive-End Location: As indicated and approved on Shop Drawings.
    b. Direction of Shadeband Roll: Regular, from back (exterior face) of roller, unless otherwise indicated on Drawings.

4. Shadeband-to-Roller Attachment: Removable spline fitting into integral channel in tube.

D. Mounting Hardware: Brackets or endcaps, corrosion resistant and compatible with roller mounting configuration, roller assemblies, operating mechanisms, installation accessories, and installation locations and conditions indicated.

E. Inside Shadebands:

1. Shadeband Material: Light-filtering fabric.
2. Shadeband Bottom (Hem) Bar: Steel or extruded aluminum.

    a. Type: Enclosed in sealed pocket of shadeband material.

F. Outside Shadebands:

1. Shadeband Material: Light-blocking fabric.
2. Shadeband Bottom (Hem) Bar: Steel or extruded aluminum.

    a. Type: Exposed with endcaps and integral light seal where bottom (sill) channels are indicated.

G. Installation Accessories:

1. Front Fascia: Aluminum extrusion that conceals front and underside of roller and operating mechanism and attaches to roller endcaps without exposed fasteners.

    a. Shape: L-shaped.
    b. Height: Manufacturer's standard height required to conceal roller and shadeband assembly when shade is fully open, but not less than 4 inches.

2. Recessed Shade Pocket: Rectangular, extruded-aluminum enclosure designed for recessed ceiling installation; with front, top, and back formed as one piece, end plates, and removable bottom closure panel.

    a. Height: Manufacturer's standard height required to enclose roller and shadeband assembly when shade is fully open, but not less than height indicated on Drawings.
    b. Where applicable, provide pocket with lip at lower edge to support acoustical ceiling panel.

3. Closure Panel and Wall Clip: Removable aluminum panel designed for installation at bottom of site-constructed ceiling recess or pocket and for snap-in attachment to wall clip without fasteners.

    a. Closure-Panel Width: 2 inches.

4. Side Channels: With light seals and designed to eliminate light gaps at sides of shades as shades are drawn down. Provide side channels with shadeband guides or other means of aligning shadebands with channels at tops.
5. Bottom (Sill) Channel or Angle: With light seals and designed to eliminate light gaps at bottoms of shades when shades are closed.
6. Installation Accessories Color and Finish: As selected from manufacturer's full range.

2.5 SHADEBAND MATERIALS

A. Shadeband Material Flame-Resistance Rating: Comply with NFPA 701. Testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

B. Light-Filtering Fabric: Woven fabric, stain and fade resistant.

1. Source: Roller shade manufacturer.
2. Type: PVC-coated polyester.
3. Weave: Basketweave.
4. Thickness: 0.036 inch.
5. Weight: 20 oz./sq. yd..
6. Orientation on Shadeband: As required based on maximum available roll width.
7. Openness Factor: 3 percent.
8. Color: As preselected and indicated in Finish Schedule.

C. Light-Blocking Fabric: Opaque fabric, stain and fade resistant.

1. Source: Roller shade manufacturer.
2. Type: Fiberglass textile with PVC film bonded to both sides.
3. Thickness: 0.013 in.
4. Weight: 12.50 oz./sq. yd..
5. Orientation on Shadeband: As required based on maximum available roll width.
6. Color: As preselected and indicated in Finish Schedule.

2.6 ROLLER SHADE FABRICATION

A. Product Safety Standard: Fabricate roller shades to comply with WCMA A 100.1, including requirements for flexible, chain-loop devices; lead content of components; and warning labels.

B. Unit Sizes: Fabricate units in sizes to fill window and other openings as follows, measured at 74 deg F:

1. Between (Inside) Jamb Installation: Width equal to jamb-to-jamb dimension of opening in which shade is installed less 1/4 inch per side or 1/2-inch total, plus or minus 1/8 inch. Length equal to head-to-sill or -floor dimension of opening in which shade is installed less 1/4 inch, plus or minus 1/8 inch.

2. Outside of Jamb Installation: Width and length as indicated, with terminations between shades of end-to-end installations at centerlines of mullion or other defined vertical separations between openings.

C. Shadeband Fabrication: Fabricate shadebands without battens or seams to extent possible, except as follows:

1. Vertical Shades: Where width-to-length ratio of shadeband is equal to or greater than 1:4, provide battens and seams at uniform spacings along shadeband length to ensure shadeband tracking and alignment through its full range of movement without distortion of the material.
2. Railroaded Materials: Railroad material where material roll width is less than the required width of shadeband and where indicated. Provide battens and seams as required by railroaded material to produce shadebands with full roll-width panel(s) plus, if required, one partial roll-width panel located at top of shadeband.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, operational clearances, locations of connections to building electrical system, and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 ROLLER SHADE INSTALLATION

A. Install roller shades level, plumb, and aligned with adjacent units according to manufacturer's written instructions.

1. Opaque Shadebands: Located so shadeband is not closer than 2 inches to interior face of glass. Allow clearances for window operation hardware.

B. Electrical Connections: Connect motor-operated roller shades to building electrical system.

C. Roller Shade Locations: As indicated on Drawings.

3.3 ADJUSTING

A. Adjust and balance roller shades to operate smoothly, easily, safely, and free from binding or malfunction throughout entire operational range.

3.4 CLEANING AND PROTECTION

A. Clean roller shade surfaces, after installation, according to manufacturer's written instructions.

B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that roller shades are without damage or deterioration at time of Substantial Completion.

C. Replace damaged roller shades that cannot be repaired, in a manner approved by Architect, before time of Substantial Completion.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain motor-operated roller shades.

END OF SECTION

SECTION 12 36 23.13 - PLASTIC-LAMINATE-CLAD COUNTERTOPS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Plastic-laminate-clad countertops.

1.2 ACTION SUBMITTALS

A. Product Data:

1. Plastic-laminate-clad countertops.

B. Product Data Submittals: For each product.

C. Sustainable Design Submittals:

1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.
2. Chain-of-Custody Certificates: For certified wood products. Include statement of costs.
3. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting materials.
4. Product Data: For installation adhesives, indicating VOC content.
5. Laboratory Test Reports: For installation adhesives, indicating compliance with requirements for low-emitting materials.
6. Laboratory Test Reports: For composite wood products, indicating compliance with requirements for low-emitting materials.

D. Shop Drawings: For plastic-laminate-clad countertops.

1. Include plans, sections, details, and attachments to other work. Detail fabrication and installation, including field joints.
2. Show locations and sizes of cutouts and holes for items installed in plastic-laminate-clad countertops.

E. Samples for Verification: As follows:

1. Plastic Laminates: For each type, color, pattern, and surface finish required, 12 by 12 inches in size.
2. Fabrication Sample: For each type and profile of countertop required, provide one sample applied to core material with specified edge material applied to one edge and including backsplash.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For fabricator.

B. Product Certificates: For the following:

1. Composite wood products.
2. High-pressure decorative laminate.
3. Adhesives.

1.4 QUALITY ASSURANCE

A. Fabricator Qualifications: Shop that employs skilled workers who custom fabricate products similar to those required for this Project and whose products have a record of successful in-service performance.

1. Shop Certification: AWI's Quality Certification Program accredited participant.

B. Installer Qualifications: Fabricator of products.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver countertops only after casework and supports on which they will be installed have been completed in installation areas.

B. Store countertops in areas where environmental conditions comply with requirements specified in "Field Conditions" Article.

C. Keep surfaces of countertops covered with protective covering during handling and installation.

1.6 FIELD CONDITIONS

A. Environmental Limitations without Humidity Control: Do not deliver or install countertops until building is enclosed, wet-work is complete, and HVAC system is operating and maintaining temperature and relative humidity at levels planned for building occupants during the remainder of the construction period.

B. Established Dimensions: Where countertops are indicated to fit to other construction, establish dimensions for areas where countertops are to fit. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

PART 2 - PRODUCTS

2.1 PLASTIC-LAMINATE-CLAD COUNTERTOPS

A. Quality Standard: Unless otherwise indicated, comply with the "Architectural Woodwork Standards" for grades of plastic-laminate-clad countertops indicated for construction, finishes, installation, and other requirements.

1. The Contract Documents contain requirements that are more stringent than the referenced quality standard. Comply with requirements of Contract Documents in addition to those of the referenced quality standard.

B. Grade: Premium.

C. Regional Materials: To the extent required to comply with the minimum criteria specified in Section 01 81 13.14 “Sustainable Design Requirements,” manufacture wood products within 100 miles of Project site from materials that have been extracted, harvested, or recovered, as well as manufactured, within 100 miles of Project site.

D. Certified Wood: Certify wood products as "FSC Pure" or "FSC Mixed Credit" in accordance with FSC STD-01-001 and FSC STD-40-004.

E. High-Pressure Decorative Laminate: ISO 4586-3, Grade HGS.

F. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:

1. As preselected and indicated in Finish Schedule.

G. Edge Treatment: Same as laminate cladding on horizontal surfaces as indicated on Drawings.

H. Core Material: Particleboard or MDF.

I. Core Material at Sinks: Particleboard made with exterior glue.

J. Core Thickness: 3/4 inch.

1. Where indicated on Drawings, build up countertop thickness to 1-1/2 inches at front, back, and ends with additional layers of core material laminated to top.

K. Backer Sheet: Provide plastic-laminate backer sheet, ISO 4586-3, grade to match exposed surface, on underside of countertop substrate.

2.2 WOOD MATERIALS

A. Wood Products: Provide materials that comply with requirements of referenced quality standard unless otherwise indicated.

1. Wood Moisture Content: 5 to 10 percent.

B. Composite Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of countertop and quality grade specified unless otherwise indicated.

1. Composite Wood Products: Verify products are made using ultra-low-emitting formaldehyde resins, as defined in the California Air Resources Board's "Airborne Toxic Control Measure to Reduce Formaldehyde Emissions from Composite Wood Products," or are made with no added formaldehyde.
2. Recycled Content of MDF and Particleboard: Provide products with postconsumer recycled content plus one-half of preconsumer recycled content to the extent required to comply with the minimum criteria specified in Section 01 81 13.14 “Sustainable Design Requirements.”
3. MDF: Medium-density fiberboard, ANSI A208.2, Grade 130.
4. Particleboard: ANSI A208.1, Grade M-2; Grade M-2-Exterior Glue.

2.3 MISCELLANEOUS MATERIALS

A. Adhesives: Use adhesives that meet the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

B. Adhesive for Bonding Plastic Laminate: Type I, waterproof type as selected by fabricator to comply with requirements.

1. Adhesive for Bonding Edges: Hot-melt adhesive or adhesive specified above for faces.

C. Installation Adhesive:

1. Verify adhesives have a VOC content of 70 g/L or less.
2. Verify adhesive complies with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

2.4 FABRICATION

A. Fabricate countertops to dimensions, profiles, and details indicated. Provide front and end overhang of 1 inch over base cabinets, unless indicated otherwise on Drawings.

B. Complete fabrication, including assembly, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.

C. Shop cut openings to maximum extent possible to receive appliances, plumbing fixtures, electrical work, and similar items. Locate openings accurately, and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.

PART 3 - EXECUTION

3.1 PREPARATION

A. Before installation, condition countertops to average prevailing humidity conditions in installation areas.

B. Before installing countertops, examine shop-fabricated work for completion and complete work as required, including removal of packing.

3.2 INSTALLATION

A. Grade: Install countertops to comply with same grade as item to be installed.

B. Assemble countertops and complete fabrication at Project site to the extent that it was not completed in the shop.

C. Field Jointing: Where possible, make in the same manner as shop jointing, using dowels, splines, adhesives, and fasteners recommended by manufacturer. Prepare edges to be joined in shop so Project-site processing of top and edge surfaces is not required. Locate field joints where shown on Shop Drawings.

1. Secure field joints in countertops with concealed clamping devices located within 6 inches of front and back edges and at intervals not exceeding 24 inches. Tighten in accordance with manufacturer's written instructions to exert a constant, heavy-clamping pressure at joints.

D. Scribe and cut countertops to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.

E. Countertop Installation: Anchor securely by screwing through corner blocks of base cabinets or other supports into underside of countertop.

1. Install countertops level and true in line. Use concealed shims as required to maintain not more than a 1/8-inch-in-96-inches variation from a straight, level plane.
2. Secure backsplashes to walls with adhesive.
3. Seal joints between countertop and backsplash, if any, and joints where countertop and backsplash abut walls with mildew-resistant silicone sealant or another permanently elastic sealing compound recommended by countertop material manufacturer.

3.3 ADJUSTING AND CLEANING

A. Repair damaged and defective countertops, where possible, to eliminate functional and visual defects. Where not possible to repair, replace countertops. Adjust joinery for uniform appearance.

B. Clean countertops on exposed and semiexposed surfaces.

C. Protection: Provide Kraft paper or other suitable covering over countertop surfaces, taped to underside of countertop at a minimum of 48 inches o.c. Remove protection at Substantial Completion.

END OF SECTION

SECTION 12 36 61.19 - QUARTZ AGGLOMERATE COUNTERTOPS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Quartz agglomerate countertops, backsplashes, end splashes, apron fronts, and window stools.

1.2 ACTION SUBMITTALS

A. Product Data: For countertop materials.

B. Sustainable Design Submittals:

1. Chain-of-Custody Certificates: For certified wood products. Include statement of costs.
2. Product Data: For adhesives, indicating VOC content.
3. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting materials.
4. Laboratory Test Reports: For composite wood products, indicating compliance with requirements for low-emitting materials.

C. Shop Drawings: For countertops and window stools. Show materials, finishes, edge and backsplash profiles, methods of joining, and cutouts for plumbing fixtures.

1. Show locations and details of joints.
2. Show direction of directional pattern, if any.

D. Samples for Verification: For the following products:

1. Countertop material, 6 inches square.
2. One full-size quartz agglomerate countertop, with front edge and backsplash, 12 by 12 inches of construction and in configuration specified.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For fabricator.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For quartz agglomerate countertops to include in maintenance manuals. Include Product Data for care products used or recommended by Installer and names, addresses, and telephone numbers of local sources for products.

1.5 QUALITY ASSURANCE

A. Fabricator Qualifications: Shop that employs skilled workers who custom-fabricate countertops similar to that required for this Project, and whose products have a record of successful in-service performance.

B. Installer Qualifications: Fabricator of countertops.

1.6 FIELD CONDITIONS

A. Field Measurements: Verify dimensions of countertops by field measurements after base cabinets are installed but before countertop fabrication is complete.

1.7 COORDINATION

A. Coordinate locations of utilities that will penetrate countertops or backsplashes.

PART 2 - PRODUCTS

2.1 QUARTZ AGGLOMERATE COUNTERTOP MATERIALS

A. Quartz Agglomerate: Solid sheets consisting of quartz aggregates bound together with a matrix of polymers, resins, and pigment and complying with ISFA 3-01.

1. Basis-of-Design Product: Subject to compliance with requirements, provide products by **Cambria** or a comparable product by one of the following:

a. Cosentino North America; C&C North America, Inc.
b. DuPont; DuPont de Nemours, Inc.
c. Wilsonart LLC.

2. Colors and Patterns: As preselected and indicated in Finish Schedule.

B. Composite Wood Products: Verify products are made using ultra-low-emitting formaldehyde resins, as defined in the California Air Resources Board's "Airborne Toxic Control Measure to Reduce Formaldehyde Emissions from Composite Wood Products," or are made with no added formaldehyde.

C. Particleboard: ANSI A208.1, Grade M-2.

2.2 FABRICATION

A. Fabricate countertops and window stools according to quartz agglomerate manufacturer's written instructions and the AWI/AWMAC/WI's "Architectural Woodwork Standards."

1. Grade: Premium.

B. Configuration: As indicated on Drawings.

C. Fabricate tops and window stools with shop-applied edges unless otherwise indicated. Comply with quartz agglomerate manufacturer's written instructions for adhesives, sealers, fabrication, and finishing.

D. Joints:

1. Fabricate countertops without joints to the extent possible.
2. Where countertops without joints are not possible, fabricate countertops in sections for joining in field, with joints at locations approved on Shop Drawings.

a. Joint Locations: Not within 18 inches of a sink or cooktop and not where a countertop section less than 36 inches long would result, unless unavoidable.
b. Joint Type, Bonded: 1/32 inch or less in width.
c. Splined Joints: Accurately cut kerfs in edges at joints for insertion of metal splines to maintain alignment of surfaces at joints. Make width of cuts slightly more than thickness of splines to provide snug fit. Provide at least three splines in each joint.

E. Cutouts and Holes:

1. Undercounter Plumbing Fixtures: Make cutouts for fixtures in shop using template or pattern furnished by fixture manufacturer. Form cutouts to smooth, even curves.

a. Provide vertical edges, slightly eased at juncture of cutout edges with top and bottom surfaces of countertop and projecting 3/16 inch into fixture opening.

2. Fittings: Drill countertops in shop for plumbing fittings, undercounter soap dispensers, and similar items.

2.3 INSTALLATION MATERIALS

A. Adhesive: Product recommended by quartz agglomerate manufacturer.

1. Verify adhesives have a VOC content of 70 g/L or less.
2. Verify adhesive complies with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

B. Sealant for Countertops and Window Stools: Comply with applicable requirements in Section 07 92 00 "Joint Sealants."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates to receive quartz agglomerate countertops and conditions under which countertops will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of countertops.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install countertops and window stools level to a tolerance of 1/8 inch in 8 feet, 1/4 inch maximum. Do not exceed 1/64-inch difference between planes of adjacent units.

B. Fasten subtops to cabinets by screwing through subtops into cornerblocks of base cabinets. Shim as needed to align subtops in a level plane.

C. Secure countertops to subtops with adhesive according to quartz agglomerate manufacturer's written instructions. Align adjacent surfaces and, using adhesive in color to match countertop, form seams to comply with quartz agglomerate manufacturer's written instructions. Carefully dress joints smooth, remove surface scratches, and clean entire surface.

D. Bond joints with adhesive and draw tight as countertops are set. Mask areas of countertops adjacent to joints to prevent adhesive smears.

1. Clamp units to temporary bracing, supports, or each other to ensure that countertops are properly aligned and joints are of specified width.

E. Install backsplashes and end splashes by adhering to wall and countertops with adhesive. Mask areas of countertops and splashes adjacent to joints to prevent adhesive smears.

F. Install aprons to backing and countertops with adhesive. Mask areas of countertops and splashes adjacent to joints to prevent adhesive smears. Fasten by screwing through backing. Predrill holes for screws as recommended by manufacturer.

G. Complete cutouts not finished in shop. Mask areas of countertops adjacent to cutouts to prevent damage while cutting. Make cutouts to accurately fit items to be installed, and at right angles to finished surfaces unless beveling is required for clearance. Ease edges slightly to prevent snipping.

1. Seal edges of cutouts in particleboard subtops by saturating with varnish.

H. Apply sealant to gaps at walls; comply with Section 079200 "Joint Sealants."

END OF SECTION

SECTION 12 93 00 - SITE FURNISHINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Bicycle racks.

B. Related Requirements:

1. Division 03 Section "Cast-in-Place Concrete" for concrete footings.
2. Division 31 Section "Earth Moving" for excavation for installing concrete footings.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For each exposed product and for each color and texture specified.

C. Samples for Initial Selection: For units with factory-applied finishes.

D. Samples for Verification: For each type of exposed finish, not less than 6-inch- (152-mm-) long linear components and 4-inch- (102-mm-) square sheet components.

E. Product Schedule: For site furnishings. Use same designations indicated on Drawings.

1.3 CLOSEOUT SUBMITTALS

A. Maintenance Data: For site furnishings to include in maintenance manuals.

PART 2 - PRODUCTS

2.1 BICYCLE RACKS (drawing detail 1/L0-601)

A. Products: Subject to compliance with requirements, provide the following:

1. “Bola” Bicycle Rack manufactured by Landscape Forms
2. Contact Information:
   Landscape Forms, Inc.,
   7800 E. Michigan Ave.
   Kalamazoo, Michigan 49048.
   Phone: (800) 521-2546. Fax (269) 381-3455.
   Website www.landscapeforms.com
   E-mail: specify@landscapeforms.com

B. Bicycle Rack Construction:

1. Material: Stainless steel.

a. Stainless Steel, Type 304 ASTM A554. Outside diameter 1.5 inches, wall thickness: 0.112 inches

2. Style: As indicated.

a. Overall Height: 32 inches.
b. Overall Width: 28 inches.
c. Overall Depth: 1.5 inches**.**
d. Weight: 13 lbs.
e. Capacity: Designed to accommodate no fewer than two bicycles.

3. Installation Method: As indicated.

C. Stainless-Steel Finish: Electropolish finish.

D. Recycled Content:

1. Post-Consumer Material Content: Minimum 50 percent.
2. Pre-Consumer Material Content: Minimum 15 percent.
3. Recyclable: 100 percent

E. Fabrication

1. Shop assembled bicycle rack.

2.2 GENERAL FINISH REQUIREMENTS

A. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.3 STAINLESS-STEEL FINISHES

A. Surface finish: Electropolished

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for correct and level finished grade, mounting surfaces, installation tolerances, and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Comply with manufacturer's written installation instructions unless more stringent requirements are indicated. Complete field assembly of site furnishings where required.

B. Unless otherwise indicated, install site furnishings after landscaping and paving have been completed.

C. Install site furnishings level, plumb, true, and securely anchored or positioned as indicated and at locations indicated on Drawings.

D. Posts Set into Voids in Concrete: Form or core-drill holes for installing posts in concrete to depth recommended in writing by manufacturer of site furnishings and 3/4 inch (19 mm) larger than OD of post. Clean holes of loose material, insert posts, and fill annular space between post and concrete with anchoring cement, mixed and placed to comply with anchoring material manufacturer's written instructions, with top smoothed and shaped to shed water.

3.3 ADJUSTING

A. Finish Damage: Repair minor damage to finish to as new condition in accordance with manufacturer’s instructions and as approved by the Landscape Architect.

B. Component Damage: Remove and replace damaged components that cannot be successfully repaired as determined by the Landscape Architect.

3.4 CLEANING

A. Clean promptly after installation in accordance with manufacturer’s instructions

B. Do not use harsh cleaning materials or methods that could damage the finish.

3.5 PROTECTION

A. Protect installed furnishings to ensure that they will be without damage or deterioration at the time of Substantial Completion.

END OF SECTION

This page is intentionally left blank.

SECTION 14 21 23.16 - MACHINE ROOM-LESS ELECTRIC TRACTION PASSENGER ELEVATORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Machine-room-less electric traction passenger elevators.
2. Machine-room-less electric traction service elevators.

B. Related Requirements:

1. Section 14 27 00 “Custom Elevator Cabs and Doors” for custom elevator doors and cabs.

1.2 DEFINITIONS

A. Definitions in ASME A17.1/CSA B44 apply to work of this Section.

1.3 ACTION SUBMITTALS

A. Product Data Submittals: Include capacities, sizes, performances, operations, safety features, finishes, and similar information. Include Product Data for car enclosures, hoistway entrances, and operation, control, and signal systems.

B. Shop Drawings:

1. Include plans, elevations, sections, and large-scale details indicating service at each landing, coordination with building structure, relationships with other construction, and locations of equipment.
2. Include large-scale layout of car-control station and standby power operation control panel.
3. Indicate maximum dynamic and static loads imposed on building structure at points of support, and maximum and average power demands.

C. Samples for Verification: For exposed car, hoistway door and frame, and signal equipment finishes; 3-inch-square Samples of sheet materials; and 4-inch lengths of running trim members.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Manufacturer Certificates: Signed by elevator manufacturer certifying that hoistway, pit, and machine room layout and dimensions, as indicated on Drawings, and electrical service including

standby power generator, as shown and specified, are adequate for elevator system being provided.

C. Sample Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For elevators to include in emergency, operation, and maintenance manuals.

1. Submit manufacturer's or Installer's standard operation and maintenance manual, according to ASME A17.1/CSA B44.

B. Inspection and Acceptance Certificates and Operating Permits: As required by authorities having jurisdiction for normal, unrestricted elevator use.

C. Continuing Maintenance Proposal:

1. Submit a continuing maintenance proposal from Installer to Owner, in the form of a standard one-year maintenance agreement, starting on date initial maintenance service is concluded. State services, obligations, conditions, and terms for agreement period and for future renewal options.
2. Submit a continuing maintenance proposal from Installer to Owner with terms, conditions, and obligations as set forth in, and in same form as, a "Draft of Elevator Maintenance Agreement," starting on date initial maintenance service is concluded.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Elevator manufacturer.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle materials, components, and equipment in manufacturer's protective packaging. Store materials, components, and equipment off of ground, under cover, and in a dry location.

1.8 COORDINATION

A. Coordinate installation of inserts, sleeves, block outs, elevator equipment with integral anchors, and other items that are embedded in concrete or masonry for elevator equipment. Furnish templates, inserts, sleeves, elevator equipment with integral anchors, and installation instructions and deliver to Project site in time for installation.

B. Coordinate locations and dimensions of work specified in other Sections that relates to electric traction elevators including pit ladders; sumps and floor drains in pits; entrance subsills; electrical service; and electrical outlets, lights, and switches in hoistways, pits, and machine rooms.

1.9 WARRANTY

A. Manufacturer's Special Warranty: Manufacturer agrees to repair, restore, or replace elevator work that fails in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, operation or control system failure, including excessive malfunctions; performances below specified ratings; excessive wear; unusual deterioration or aging of materials or finishes; unsafe conditions; need for excessive maintenance; abnormal noise or vibration; and similar unusual, unexpected, and unsatisfactory conditions.
2. Warranty Period: Five year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

1. Basis-of-Design Product: Subject to compliance with requirements, provide **Otis Worldwide Corporation Gen3** or comparable product by one of the following:

a. KONE Inc.
b. Schindler Elevator Corp.

B. Source Limitations: Obtain elevators from single manufacturer.

1. Major elevator components, including driving machines, controllers, signal fixtures, door operators, car frames, cars, and entrances, shall be manufactured by single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Regulatory Requirements: Comply with ASME A17.1/CSA B44.

B. Accessibility Requirements: Comply with requirements for accessible elevators in the United States Access Board's ADA-ABA Accessibility Guidelines and with ICC A117.1.

2.3 ELEVATORS

A. Elevator System, General: Manufacturer's standard elevator systems. Unless otherwise indicated, manufacturer's standard components shall be used, as included in standard elevator systems, and as required for complete system including the following:

1. Controller located entirely inside the hoistway.
2. An AC gearless machine using embedded permanent magnets mounted at the top of the hoistway.
3. Polyurethane coated-steel belts for elevator hoisting purposes.
4. Regenerative drive that captures normally wasted energy and feeds clean power back into the building’s power grid.
5. LED lighting standard in ceiling lights and elevator fixtures.
6. Sleep mode operation for LED ceiling lights and car fan.

B. Elevator Description: Public Elevators.

1. Elevator Number(s): EL-01, EL-02.
2. Rated Load: 3500 lb.
3. Rated Speed: 350 fpm.
4. Number of Stops: 6.
5. Travel Distance: 88 feet.
6. Operation System: Group automatic operation.
7. Auxiliary Operations:

    a. Standby power operation.
    b. Off-peak operation.
    c. Automatic operation of lights and ventilation fans.

8. Dual Car-Control Stations: Provide two car-control stations in each elevator; equip only one with required keyswitches if any.
9. Car Enclosures: Custom cab as indicated in Section 14 27 00 “Custom Elevator Cabs and Doors.”
10. Hoistway Entrances:

    a. Width: 42 inches.
    b. Height: 96 inches.
    c. Type: Single-speed center opening.
    d. Frames: Clad in bronze as specified in Section 05 75 00 “Decorative Formed Metal.”
    e. Sills: Bronze.

11. Hall Fixtures: Satin bronze, lacquered.

C. Elevator Description: Judge’s Elevator

1. Elevator Number(s): EL-03.
2. Rated Load: 3500 lb.
3. Rated Speed: 350 fpm.
4. Number of Stops: 6.
5. Travel Distance: 88 feet.
6. Operation System: Selective-collective automatic operation.
7. Auxiliary Operations:

    a. Standby power operation.
    b. Automatic operation of lights and ventilation fans.

8. Security Features: Card-reader operation.
9. Car Enclosures: Custom cab as indicated in Section 14 27 00 “Custom Elevator Cabs and Doors.”
10. Hoistway Entrances:

    a. Width: 42 inches.
    b. Height: 96 inches.
    c. Type: Single-speed center opening.
    d. Frames: Clad in bronze as specified in Section 05 75 00 “Decorative Formed Metal.”
    e. Sills: Bronze.

11. Hall Fixtures: Satin bronze, lacquered.

D. Elevator Description: Service Elevator.

1. Service Elevator Number: EL-04.
2. Rated Load: 4500 lb.
3. Freight Loading Class for Service Elevator(s): Class A.
4. Rated Speed: 350 fpm.
5. Number of Stops: 7.
6. Travel Distance: 103 feet.
7. Operation System: Selective-collective automatic operation.
8. Auxiliary Operations:

    a. Standby power operation.
    b. Automatic operation of lights and ventilation fans.

9. Car Enclosures: As selected by Architect from manufacturer's standard car designs.

    a. Walls: Rigidized stainless steel
    b. Rails: Satin stainless steel, flat.
    c. Car Fixtures: Manufacturer's standard.
    d. Ceiling: 4-LED flush stainless steel.

10. Hoistway Entrances:

    a. Width: 48 inches.
    b. Height: 96 inches.
    c. Type: Front and rear, two-speed side sliding opening.
    d. Frames: Satin stainless steel.
    e. Doors: Satin stainless steel, ASTM A480/480M, No. 4 finish.
    f. Sills: Nickel silver.

11. Hall Fixtures: Satin stainless steel, ASTM A480/480M, No. 4 finish.
12. Additional Requirements:

    a. Provide inspection certificate in each car, mounted under acrylic cover with frame made from satin stainless steel, ASTM A480/480M, No. 4 finish.
    b. Provide hooks for protective pads and one complete set(s) of full-height protective pads.

E. Elevator Description: Law Library Elevator

1. Elevator Number(s): EL-05.
2. Rated Load: 3500 lb.
3. Rated Speed: 350 fpm.
4. Number of Stops: 2.
5. Travel Distance: 35 feet.
6. Operation System: Selective-collective automatic operation.
7. Auxiliary Operations:

    a. Standby power operation.
    b. Automatic operation of lights and ventilation fans.

8. Security Features: Card-reader operation.
9. Car Enclosures: As selected by Architect from manufacturer's standard car designs.

    a. Walls: Bronze sheet
    b. Rails: Bronze, flat.
    c. Car Fixtures: Manufacturer's standard.
    d. Ceiling: 4-LED flush bronze.

10. Hoistway Entrances:

    a. Width: 42 inches.
    b. Height: 96 inches.
    c. Type: Single-speed center opening.
    d. Frames: Clad in bronze as specified in Section 05 75 00 "Decorative Formed Metal."
    e. Sills: Bronze.

11. Hall Fixtures: Satin bronze, lacquered.

2.4 CONTROLLER COMPONENTS

A. Controller: A microcomputer-based control system shall be provided to perform all of the functions of safe elevator operation. The system shall also perform car and group operational control.

1. Protect all high voltage contact points (110V or above) inside the controller from accidental contact when the controller doors are open.
2. Separate controller into two distinct halves: Motor Drive side and Control side. Rout high voltage motor power conductors so as to be physically segregated from the rest of the controller.
3. Segregate field conductor terminations points; high voltage (greater than 30 volts DC and 110 VAC,) and low voltage (less than 30 volts DC).
4. Design and test controllers for Electromagnetic Interference (EMI) immunity according to the EN 12016 (May 1998): "EMC Product Family Standards for lifts, escalators, and passenger conveyors Part 2 – immunity"
5. Locate controller inside the wall next to the top landing entrance frame. Provide emergency access through an access panel in the entrance frame secured by a key lock.

B. Drive: Provide a variable voltage variable frequency AC drive system. Set drive up for regeneration of AC power back to the building grid.

2.5 HOISTWAY COMPONENTS

A. Machine: AC gearless machine, with a synchronous permanent-magnet motor, dual solenoid service and emergency disc brakes, mounted at the top of the hoistway.

B. Governor: Provide tension type car-mounted governor.

C. Buffers, Car, and Counterweight: Use polyurethane type buffers for speeds of 150 and 200 feet per minute. Use oil buffers for a speed of 350 feet per minute.

D. Hoistway Operating Devices: Provide the following:

1. Emergency stop switch in the pit.
2. Terminal stopping switches.

E. Positioning System: Consists of an encoder, reader box, and door zone vanes.

F. Guide Rails and Attachments: Provide tee-section steel rails with brackets and fasteners. For side counterweight arrangements provide a dual-purpose bracket that combines both counterweight guide rails and one of the car guide rails to building fastening.

G. Coated-Steel Belts: Polyurethane coated belts with high-tensile-grade, zinc-plated steel cords and a flat profile on the running surface and the backside of the belt. Provide belts with an FT-1 rating as referenced by NFPA 13. All driving sheaves and deflector sheaves to have a crowned profile to ensure center tracking of the belts. Provide a continuous 24/7 monitoring system using resistance-based technology to continuously monitor the integrity of the coated steel belts and provide advanced notice of belt wear.

H. Governor Rope: Steel consisting of at least eight strands wound about a sisal core center.

I. Fascia: Provide galvanized sheet steel at the front of the hoistway.

J. Hoistway Entrances:

1. Frames: Provide entrance frames of bolted construction for a complete one-piece unit assembly. Securely fasten all frames to fixing angles mounted in the hoistway and shall be of UL fire rated steel.
2. Sills: Extruded nickel silver.
3. Doors: Provide entrance doors of metal construction with vertical channel reinforcements.
4. Fire Rating: Entrance and doors shall be UL fire rated for 1-1/2 hour.
5. Entrance Finish: Satin stainless steel.
6. Entrance Marking Plates: Provide entrance jambs with 4 by 4 inch plates having raised floor markings with Braille located adjacent to the floor marking. Provide marking plates on both sides of the entrance.
7. Sight Guards: Furnish sight guards with all doors painted to match with painted doors and painted black for stainless steel doors.

2.6 CAR COMPONENTS

A. Car Frame and Safety: Provide a car frame fabricated from formed or structural steel members provided with adequate bracing to support the platform and car enclosures. Provide Type "B", flexible guide clamp type car safety integral to the car frame.

B. Cab: Steel shell cab with wall panels as specified above,

C. Car Front Finish: As specified above.

D. Car Door Finish: As specified above.

E. Ceiling Type: Dropped ceiling with LED lights.

F. Car Front Finish: As specified above.

G. Car Door Finish: As specified above.

H. Ceiling Finish: As specified above.

I. Emergency Car Lighting: Provide an emergency power unit employing a 6-volt sealed rechargeable battery and totally static circuits to illuminate the elevator car in the event of building power failure.

J. Fan: Mount a one-speed 120 VAC fan to the ceiling to facilitate in-car air circulation, meeting ASME A17.1 requirements. Rubber mount fan to prevent the transmission of structural vibration and include a baffle to diffuse audible noise. Provide a switch in the car-operating panel to control the fan.

K. Handrails: Provide 3/8 by 2 inch flat tubular bar handrails on the side walls of material specified above.

L. Threshold: As specified above

M. Emergency Exit Contact: Provide an electrical contact on the car-top exit.

N. Guides: Provide car with 3 inch diameter roller guides at top and bottom and counterweight with slide type guides at the top and the bottom.

O. Platform: Construct the car platform of metal. Mount load weighing device on the belts at the top of the hoistway.

P. LED ceiling lights and the fan automatically shut off when the system is not in use and be powered back up after a passenger calls the elevator and pushes a hall button.

Q. Certificate frame: Provide a certificate frame with metal finish to match cab metal.

2.7 SIGNAL DEVICES AND FIXTURES

A. Car Operating Panel: Provide a metal finished standard applied car operating panel front and back which contains all push buttons, key switches, and message indicators for elevator operation.

1. Provide car operating panel with a bank of round metal, mechanical LED illuminated buttons, flush mounted to the panel and marked to correspond to the landings served. All buttons to have raised numerals and Braille markings.
2. Equip car operating panel with the following features:

    a. Raised markings and braille to the left-hand side of each push-button.
    b. Car Position Indicator at the top of and integral to the car operating panel.
    c. Door open and door close buttons.
    d. Inspection key-switch.
    e. Elevator data plate marked with elevator capacity.
    f. Provide a help button that initiates two-way communication between the car and a location inside the building, switching over to another location if the call is unanswered, where personnel are available who can take the appropriate action. Provide visual indicators for call initiation and call acknowledgement.

g. Landing Passing Signal: Provide a chime bell that sounds in the car to signal that the car is either stopping at or passing a floor served by the elevator.
h. In car stop key switch.
i. Firefighter's hat.
j. Firefighter's Phase II key-switch.
k. Call Cancel Button.

B. Car Position Indicator: Provide a digital, LED car position indicator integral to the car operating panel.

C. Hall Fixtures: Provide hall fixtures with necessary push buttons and key switches for elevator operation.

1. Provide integral hall fixtures featuring round metal, mechanical buttons marked to correspond to the landings. Locate hall fixtures in the entrance frame face with buttons mounted vertically. Provide fixture with metal finish indicated above.
2. Car Lantern and Chime: Provide a directional lantern visible from the corridor in the car entrance with the following features:

a. When the car stops and the doors are opening, the lantern indicates the direction in which the car is to travel, and a chime will sound.

3. Access key-switch at top floor in entrance jamb.
4. Access key-switch at lowest floor in entrance jamb.
5. Make provision for card reader including necessary traveler cables.
6. Make provision for surveillance camera including necessary traveler cables.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine elevator areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work. Examine hoistways, hoistway openings, pits, and machine rooms as constructed; verify critical dimensions; and examine supporting structure and other conditions under which elevator work is to be installed.

B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with manufacturer's written instructions.

B. Welded Construction: Provide welded connections for installing elevator work where bolted connections are not required for subsequent removal or for normal operation, adjustment, inspection, maintenance, and replacement of worn parts. Comply with AWS standards for workmanship and for qualifications of welding operators.

C. Sound Isolation: Mount rotating and vibrating equipment on vibration-isolating mounts to minimize vibration transmission to structure and structure-borne noise due to elevator system.

D. Lubricate operating parts of systems, including ropes, as recommended by manufacturers.

E. Alignment: Coordinate installation of hoistway entrances with installation of elevator guide rails for accurate alignment of entrances with car. Where possible, delay final adjustment of sills and doors until car is operable in shaft. Reduce clearances to minimum, safe, workable dimension at each landing.

F. Leveling Tolerance: 1/8 inch, up or down, regardless of load and travel direction.

G. Set sills flush with finished floor surface at landing. Fill space under sill solidly with nonshrink, nonmetallic grout.

H. Locate hall signal equipment for elevators as follows unless otherwise indicated on Drawings:

1. For groups of elevators, locate hall push-button stations between two elevators at center of group or at location most convenient for approaching passengers.
2. Place hall lanterns either above or beside each hoistway entrance.
3. Mount hall lanterns at a minimum of 72 inches above finished floor.

3.3 FIELD QUALITY CONTROL

A. Acceptance Testing: On completion of elevator installation and before permitting elevator use (either temporary or permanent), perform acceptance tests as required and recommended by ASME A17.1/CSA B44 and by governing regulations and agencies.

B. Advise Owner, Architect, and authorities having jurisdiction in advance of dates and times that tests are to be performed on elevators.

3.4 PROTECTION

A. Temporary Use: Limit temporary use for construction purposes to one service elevator only. Comply with the following requirements for elevator used for construction purposes:

1. Provide car with temporary enclosure, either within finished car or in place of finished car, to protect finishes from damage.
2. Provide strippable protective film on entrance and car doors and frames.
3. Provide padded wood bumpers on entrance door frames covering jambs and frame faces.
4. Provide other protective coverings, barriers, devices, signs, and procedures as needed to protect elevator and elevator equipment.
5. Do not load elevators beyond their rated weight capacity.
6. Engage elevator Installer to provide full maintenance service. Include preventive maintenance, repair or replacement of worn or defective components, lubrication, cleanup, and adjustment as necessary for proper elevator operation at rated speed and capacity. Provide parts and supplies same as those used in the manufacture and installation of original equipment.

7. Engage elevator Installer to restore damaged work, if any, so no evidence remains of correction. Return items that cannot be refinished in the field to the shop, make required repairs and refinish entire unit, or provide new units as required.

3.5 MAINTENANCE SERVICE

A. Initial Maintenance Service: Beginning at Substantial Completion, maintenance service to include 12 months' full maintenance by skilled employees of elevator Installer. Include monthly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper elevator operation at rated speed and capacity. Parts and supplies to be manufacturer's authorized replacement parts and supplies.

1. Perform maintenance during normal working hours.
2. Perform emergency callback service during normal working hours with response time of two hours or less.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to operate elevator(s).

B. Check operation of elevator with Owner's personnel present before date of Substantial Completion and again not more than one month before end of warranty period. Determine that operation systems and devices are functioning properly.

END OF SECTION

This page is intentionally left blank.

SECTION 14 27 00 - CUSTOM ELEVATOR CABS AND DOORS

PART 1 - GENERAL

1.1 SUMMARY

A. Description of Work: Provide custom cabs comprised of materials, finishes, and design to be issued after Contract award at the following locations:

1. EL-01, EL-02: Public Elevators.
2. EL-03: Judge’s Elevators.

B. Section Includes: Custom elevator cabs and entrances.

PART 2 - PRODUCTS

2.1 MATERIALS

A. As indicated on Drawings to be issued after Contract award for entrances, floors, walls, ceiling, and railings.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with manufacturer's written instructions.

B. Coordinate work with installation of machine room-less electric traction passenger elevators and provide installation of custom elevator entrance and cabs complete.

END OF SECTION

This page is intentionally left blank.

SECTION 21 05 00 - COMMON WORK RESULTS FOR FIRE SUPPRESSION

PART 1 - GENERAL

1.1 REFER TO RELATED SECTIONS

A. Section 23 05 01 – Mechanical and Electrical Coordination
Section 23 05 02 – Basic Mechanical Requirements
Section 23 05 03 – Basic Mechanical Material and Methods
Section 23 05 13 – Motors and Starters
Section 23 05 21 – Pipe and Pipe Fittings
Section 23 05 22 – Piping Accessories
Section 23 05 23 – Valves
Section 23 05 29 – Pipe Support and Anchors
Section 23 05 30 – Electronic Speed Controllers
Section 23 05 48 – Vibration Control
Section 23 05 53 – Mechanical Identification

PART 2 - PRODUCTS – NOT USED

PART 3 - EXECUTION – NOT USED

END OF SECTION

This page is intentionally left blank.

SECTION 21 08 00 - COMMISSIONING OF FIRE SUPPRESSION SYSTEM

PART 1 - GENERAL

1.1 REFER TO RELATED SECTIONS

A. Section 23 08 00 – Building Mechanical System Commissioning.
Section 23 08 01 – Commissioning Agent Requirements

PART 2 - PRODUCTS – NOT USED

PART 3 - EXECUTION – NOT USED

END OF SECTION

This page is intentionally left blank.

SECTION 21 13 00 - FIRE SUPPRESSION SPRINKLER SYSTEMS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Provide a complete fire protection system as indicated on the Drawings and as specified herein consisting of the following but not limited thereto.

1. Wet and/or dry standpipe system.
2. Wet, dry, deluge and pre-action fire sprinkler systems.
3. Exterior fire protection piping system.
4. Fire hydrants.
5. Fire extinguishers.
6. Fire pump, jockey pump and controllers.
7. Temporary standpipes for construction.

B. It is the intent of this Specification for the Contractor to provide complete hydraulically designed wet and dry pipe sprinkler systems for the areas indicated in these Specifications and shown on the Contract Drawings. This Contractor shall be the Engineer of record for the fire sprinkler system. Furnish all design, material, and labor to complete the contract within the intent of these Specifications and Contract Drawings even though each and every item necessary is not specifically mentioned or shown.

1.2 QUALITY ASSURANCE

A. Contractor Qualifications: Work shall be performed by a Contractor regularly engaged in the design and installation of fire protection systems in accordance with NFPA requirements and having at least three years continuous experience in this type of work. Experience shall include projects of similar type, size and complexity.

B. Design Criteria: Provide fire protection systems of types, pressure, flow and densities required by the prevailing edition of the NFPA 13 and regulatory agencies having jurisdiction.

1. Systems shall be calculated and of configuration acceptable to regulatory agencies.
2. For bidding purposes, base calculations on 53 psig residual pressure at 1000 gpm flow rate at the entry of the fire line into the building.
3. Contractor to obtain a current flow test at the start of the project to verify need for fire pump and to use for the basis of the hydraulic calculations.

    a. Contractor to notify the design team if the flow test is different than what is indicated and will impact the fire protection design.

4. Provide sprinkler head densities per NFPA 13 and as shown on documents.
5. Fire pump shown on the plans is of adequate size to serve the system. Notify engineer prior to bid if this does not appear to be the case. Pressure losses throughout the system shall be within the capacity of the scheduled pump. The contractor may propose, at their option, increased pressure loss due to reduced system pipe sizing resulting in a larger pump. It will be the contractor’s responsibility to cover all costs (space requirements, electrical impact, etc.) associated with the increased pump size and horsepower.

C. Pipe sizes shown on drawings may be larger than minimum required. This is to accommodate additional partitioning. Do not reduce sizes.

D. Requirements of Regulatory Agencies: Total system shall be acceptable upon completion and testing in accordance with the requirements of the following:

1. Jurisdictional Code Enforcement Agencies
2. Jurisdictional Insurance Agency or Underwriter
3. Confirm requirements of the authority having jurisdiction and Owner's Insurance Underwriter prior to bid.

E. Certificate of Completion: Submit Certificate of Completion of fire protection work, stating that the work has been completed and tested in accordance with the specified standards, that there are no defects in the system and it is operational.

1.3 CODES AND STANDARDS

A. In addition to those specified in Section 21 05 00, comply with local fire department regulations and with the following:

1. Standpipe system
    a. UBC Standard 38-2
2. Local Water Department
3. Local Building Department
4. FM Global
5. Local Health Department
6. Local Public Works
7. Prevailing editions of NFPA 13, 14, 24
8. Local modifications to the Fire Codes
9. UL 218 Standard for Fire Pump Controllers
10. UL 1008 Automatic Transfer Switches
11. UL 508 Industrial Control Equipment
12. NFPA 20 Installation at Centrifugal Fire Pumps
13. NFPA 70 National Electrical Code

B. All materials and equipment used in the installation of the fire protection system shall be as listed in the Underwriters' Laboratories, Fire Protection Equipment Directory or approved in the Factory Mutual Approved Guide and shall be the most current product of the manufacturer, and shall bear their label.

1.4 SUBMITTALS

A. Submittal data shall be in accordance with Division 1 and the following shall be submitted for review to the Architect prior to the start of installation:

1. Material and equipment information shall include catalog cuts and technical data for each system component or device. This shall include, but not be limited to piping, fittings, globe and angle valves, O.S.&Y valves, butterfly valves, check valves, automatic sprinkler heads, escutcheons, hangers, flow switches, tamper switches, alarm valves, trim and required accessories, dry pipe valves, trim and required accessories and air compressor.

B. Prepare shop drawings showing layout of fire protection system. Use minimum scale of 1/8” = 1’-0” for floor plans. Drawings shall coordinate with all building structural features and components and show routing of piping to clear same. Drawings shall be accurately dimensioned to show proposed location of all fire protection system components. System design shall be completely coordinated with the architectural, structural, mechanical, and electrical features of the building. The drawings shall show all details required by NFPA 13 - Sprinkler System, Installation for “Working Drawings”. In all areas with suspended ceilings, reflected ceiling plans shall be prepared showing the location of sprinklers, lights, diffusers, grilles, etc.

C. Submit a complete schedule of the material and equipment proposed for this installation to the Architect/Engineer for approval. Include catalog cuts, diagrams, drawings, and such other descriptive data as may be required to clearly show what, where, and how the component is intended to be installed. In the event any items of material or equipment contained in the schedule fail to comply with the specifications, such items may be rejected.

D. Submit plans and hydraulic calculations signed and sealed by the Professional Engineer supervising the design of the fire sprinkler system, and one (1) set of reproducible of the complete shop drawings of the sprinkler system to the regulatory agencies having jurisdiction. After approvals are obtained, submit the drawings and hydraulic calculations to the Architect for review. Written approval of the Architect must be obtained before purchasing or installing any equipment.

E. Approval of submittals will not relieve the Contractor of the responsibility for correcting any errors which may exist or for meeting requirements of the specifications. No partial submittals will be accepted.

F. A set of approved installation drawings shall be kept at the job site and marked to indicate all installation conditions which are different from the approved drawings.

1.5 DESIGN REQUIREMENTS

A. It shall be the Contractor’s responsibility to size the sprinkler system pipes in accordance with the requirements of the prevailing edition of NFPA 13. Contractor shall submit all calculations to the Engineer for review at time of drawing submittal. Submittal of these calculations to the Engineer will in no way relieve the Contractor of their responsibilities for complete and proper design of the fire protection system.

B. It shall be the Contractor’s responsibility to design the system so that no interferences exist between the fire protection system and work of other trades, equipment and systems designed and installed by others. The latest issues of all architectural, structural, mechanical and electrical drawings will be furnished for reference to assist the Contractor in preparing the design so as to avoid interference.

C. This Contractor shall provide all necessary control wiring and equipment necessary for an operational system. This includes, but not limited to, key switches, releasing panels, solenoid valves, etc.

1.6 WATER SUPPLY

A. The water supply as shown on the drawings will be installed by other divisions of the work, who will provide a flange connection inside the building for the fire protection system. The fire protection Contractor shall make the required connection at this point for the fire protection system. Coordinate with General Contractor prior to bid to show the complete scope of work between civil and the fire protection contractor.

1.7 WARRANTIES

A. The entire new system shall be warranted to be free from defects for a period of one (1) year from the date of Notice of Acceptance.

1.8 PROJECT RECORD DOCUMENTS

A. Upon completion of the work, the Contractor shall revise all fire protection drawings to agree with the construction as actually accomplished and stamp “As-Built”. Those drawings where no change is involved shall be likewise stamped. These “As-Built” drawings shall show the fire protection system as it existed at the completion of the contract work.

B. See Division 1 for additional requirements.

1.9 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including the General Conditions of the Contract and Supplementary General Conditions and Division 1 - General Requirements, apply to work of this Section. This Contractor shall comply with all applicable sections of Division 21 through 23.

PART 2 - PRODUCTS

2.1 WET PIPE AND FITTINGS

A. Pipe joints above ground shall be screwed, flanged, welded, roll-grooved with mechanical couplings. Welded joints are not acceptable in pipe less than 2” in diameter. No welding permitted except with certified welders in shop.

B. Piping above ground shall be Schedule 40 black steel pipe. Thin wall schedule 10 pipe may be used when in conformance with NFPA 13 and when approved by the applicable Fire and Building departments.

C. Threaded fittings above ground shall be gray cast iron suitable for 300 psi cold water working pressure and so rated.

D. In lieu of weld, threaded, or flanged connections, mechanical type couplings and fittings as manufactured by Tyco Grinnell Grooved Piping Products and Victaulic or approved equal, may be used in piping above grade.

E. Provide escutcheons on penetrations of interior walls.

F. Below Grade:

1. Ductile iron pressure pipe, tar coated, cement lined:

a. Pipe: ANSI A21.51, Class 50
b. Fittings: ANSI 21.10
c. Rubber gaskets: ANSI 21.11

G. Any piping used shall have a UL Corrosion Ratio (CRR) of 1.00 or greater.

2.2 DRY PIPE AND FITTINGS

A. Pipe joints above ground shall be screwed, flanged, welded, cut-grooved with mechanical couplings. Rolled grooved will not be allowed in dry pipe systems. Welded joints are not acceptable in pipe less than 2” in diameter. No welding permitted except with certified welders in shop.

B. Piping above ground shall be Schedule 40 black steel pipe.

C. All fittings on galvanized piping shall be galvanized in accordance with ASTM A153.

D. Fittings shall be suitable for 175 psi cold water working pressure and so rated.

E. In lieu of weld, threaded, or flanged connections, mechanical type couplings and fittings as manufactured by Tyco Grinnell Cut Grooved Piping Products and Victaulic or approved equal, may be used in piping above grade.

F. Provide escutcheons on penetrations of interior walls.

G. Any piping used shall have a UL Corrosion Ratio (CRR) of 1.00 or greater.

H. Nitrogen Generator with Integral Air Compressor:

1. Basis-of-Design – Subject to compliance with requirements, provide Engineered Corrosion Solutions Nitrogen Generator.
2. The nitrogen generator shall be wall mounted with integral air compressor sized to provide all dry and preaction fire sprinkler systems with supervisory nitrogen gas. Sizing shall be based on the total volume of all fire sprinkler systems being served by the nitrogen generator as determined by hydraulic calculations for each system. Documentation of the calculations and nitrogen generator sizing must be provided with the submittals. Where the quantity of systems, total cumulative volume of systems or physical location of system risers require, multiple nitrogen generators shall be supplied.
3. The nitrogen generator shall be electronically controlled with the capability to adjust system operating pressure settings without the requirement of any additional equipment.
4. The nitrogen generator shall include an integral air compressor sized per the manufacturer’s requirements.
5. The integral air compressor shall be oil-less, be rated for continuous duty and have an output pressure rating of 100 psig.
6. The integral air compressor shall be capable of producing a continuous volume of compressed air that is sufficient to fill the largest FPS being supplied by the air compressor to operating pressure within thirty (30) minutes per NFPA 13 requirements and also meet the compressed air requirements of the nitrogen generator it is supplying.
7. The nitrogen generator shall not require a nitrogen storage tank or refrigerated dryer.

8. The nitrogen generator shall be designed to achieve a nitrogen concentration of 98% or greater within fourteen (14) days of start-up and maintain that concentration within all fire protection systems continuously.
9. The nitrogen generator shall have a connection to attach and sample the purity of nitrogen within the FPS. Purity sampling device can be portable or fixed.
10. The nitrogen generator shall be equipped with a filtration system to remove residual water and hydrocarbons (if needed) from the compressed air stream.
11. The nitrogen generator shall be powered by a 120VAC power supply. Coordinate power requirements and location with electrical contractor. The nitrogen generator power supply shall be per NFPA 70 and all local requirements.
12. The nitrogen generator shall be equipped with an internal bypass with bypass alarm to prevent long term oxygen exposure in fire sprinkler system.
13. Coordinate power requirements and location with electrical contractor. The nitrogen generator power supply shall be per NFPA 70 and all local requirements.

    a. Air Maintenance Device:

        1) The fire sprinkler contractor shall furnish and install an approved air maintenance device for each dry or preaction fire sprinkler system.
        2) The air maintenance device shall be equipped with a field adjustable pressure regulator for use in setting the maximum system pressure. Approved air maintenance devices are:

            a) Victaulic Series 757
            b) Tyco Model AMD-1
            c) Reliable Model A-2
            d) Or approved equal

        3) Air maintenance device shall be installed per the manufacturer's instructions.

    b. Integral Air Vent (electric

        1) The fire sprinkler contractor shall furnish and install an electric integral air vent for each fire sprinkler system that will close automatically once the desired nitrogen concentration has been reached.
        2) The electric integral air vent shall be installed on the fire sprinkler riser at the locations shown on the drawings. Installation of the electric integral air vent outside of the fire sprinkler valve room is not permitted.
        3) The electric integral air vent shall be equipped with a solenoid valve and separate electric control box. The electric integral air vent shall be powered by a 120VAC power supply. Coordinate power requirements and location with electrical contractor.
        4) The electric control box shall be wall mounted and installed adjacent to the integral air vent on the fire sprinkler riser. Coordinate solenoid connection requirements and location with electrical contractor.
        5) The solenoid valve shall be wired to the electric control box per NFPA 70 and all local requirements.
        6) The integral air vent shall have an adjustable pressure regulator to prevent accidental depressurization of the fire sprinkler system should a disruption occur to the air/nitrogen supply
        7) The electric integral air vent shall have a connection to attach and sample the purity of nitrogen within the FPS. Purity sampling device can be portable or fixed.

8) The piping between FPS and electric integral air vent must not create a water trap; the connecting piping must drain when FPS is drained or the electric automatic air vent will not function properly.
9) A 1/2 in. outlet is required to attach the vent assembly to the FPS.
10) The isolation ball valve of the electric automatic air vent shall be closed during hydrostatic and/or air pressure testing of the FPS and then placed in the open position for the commissioning and operation of the nitrogen generator or cylinders.

2.3 BUTTERFLY VALVES

A. Butterfly valves shall be furnished with worm gear type indicating operator to assure slow closing. Valves shall have a completely sealed shaft, integral flange seals, and hex drive.

2.4 O.S.&Y. VALVES

A. Outside stem and yoke gate valves shall be of the wedge disc type, shall permit straight line flow and complete shut-off, and shall be so designed that the valves can be packed under pressure when wide open. Valve shall be iron body, bronze trim, flanged or screwed ends, with rising stem and rated minimum 175 psi non-shock cold water service.

2.5 CHECK VALVES

A. All swing check valves shall be 175 psi non-shock cold water service, iron body, bronzed trim, horizontal swing with renewable bronze seat and rings. All check valves two (2) inches and smaller shall be bronze, screwed, horizontal swing type. All check valves two and one half (2½) inches and larger shall be flanged or grooved type.

B. All wafer check valves shall be minimum 175 psi working pressure, iron body with spring actuated double bronze plate and rubber seat.

2.6 GLOBE AND ANGLE VALVES

A. Valves shall be furnished with renewable disc, non-shock, and shall back seat in the fully opened position to allow repacking under full pressure without removing the valve from the line. Valve shall be rated for minimum 175 psi working pressure.

2.7 VALVE SUPERVISORY SWITCHES

A. All valves two inches or larger which control water to automatic sprinkler heads shall be equipped with supervisory switches having one normally open contact and one normally closed contact.

2.8 FLOW SWITCHES

A. All flow switches shall be field adjustable vane type with pneumatic retard and 175 psi working pressure. Units shall be suitable for installation by drilling pipe and securing with U-bolt furnished with the switch. Units shall be single pole double throw, suitable for 24Volt D.C. service with one normally open contact and one normally closed contact. Waterflow switches shall be adjusted so that the device will transmit a waterflow alarm within 30 seconds of opening the inspector's test valve on the sprinkler system.

2.9 TAMPER SWITCHES

A. Approved manufacturers are System Sensor, Potter Electric or equal.

B. Switch shall be listed for use on the type of valve to be monitored.

2.10 EXTERIOR ALARM

A. Approved manufacturers are Farr Alarm, Potter Electric, System Sensor.

B. Alarm shall have combination horn and light and be constructed for exterior use.

C. Furnish interior alarms where required by the authority having jurisdiction.

2.11 DRY PIPE VALVE

A. Approved manufacturers are Tyco, Viking, Victaulic and Reliable.

B. Dry pipe valve shall separate system water supply from the air-filled system piping. Valve shall have an external reset, flanged or grooved connections, gasketed hand hole cover, brass to neoprene air seat, brass-to-brass water seat, spring-loaded clapper with full open latch. Provide all accessories consisting of angle valves, globe valves, pipe nipples and fittings, water and air pressure gauges, mechanical or electrical accelerator when required and maintenance air compressor sized in conformance with NFPA 13.

2.12 AUTOMATIC FIRE SPRINKLER HEADS

A. Approved manufacturers are Tyco, Viking, Reliable, Victaulic.

B. Sprinkler heads shall have a temperature rating of 155°F except for heads in areas of high temperature and in close proximity to heat sources which shall be temperature rated in accordance with NFPA 13.

C. Sprinkler heads in ceilings to be concealed pendent.

D. Sprinkler heads in exposed areas shall be upright type, standard brass.

E. Sprinkler heads in dry-pipe systems shall be upright (where exposed) or dry-pendent type (in ceilings).

F. Sprinklers for installation in wall, ceilings, soffits or similar shall include integral escutcheon plates designed for friction or set screw fit. Escutcheon throat shall be minimum ¾" depth.

G. Coordinate exact location, type and color of all sprinkler heads, escutcheons and plates with the Architect.

H. Supply Owner an extra stock of six sprinklers minimum, three of each type, with applicable sprinkler wrenches. Sprinklers shall be packed in a suitable container for wall mounting. Provide additional heads that may be required by NFPA 13.

2.13 FIRE DEPARTMENT CONNECTION

A. Approved manufacturers are Potter-Roemer, or equal.

B. Fire department connection shall be 4-way projecting standpipe inlet with self-closing clapper valves and pin lug swivels and caps with chains equal to Potter-Roemer Series 5216 including escutcheon plate with appropriate lettering. Furnish with type of thread as directed by the local fire department and of size shown on the drawings.

2.14 FIRE HOSE VALVE

A. Approved manufacturers are Potter-Roemer, or equal.

B. 2½" Hose valve with 2½" x 1½" reducer with pin lug cap and chain, polished brass finish equal to Potter-Roemer 4065-B.

2.15 FIRE HOSE CABINET

A. Approved manufacturers are Potter-Roemer, or equal.

B. Fire hose cabinet shall be recessed 20-gauge, white, baked enamel steel box, 20-gauge tubular steel door with 18-gauge frame with a continuous steel hinge (brass pin), door and frame finished with a baked-on gray primer coat equal to Potter-Roemer 1500-A.

C. Cabinet shall contain (3½" hose valve with 2½" x 1½" reducer with pin lug cap and chain - Denver) 1½" hose rack assembly with lined hose and fog nozzle equal to Potter-Roemer; 2½" hose valve with pin lug cap and chain equal to Potter-Roemer 4065; 2½ gallon pressurized water portable fire extinguisher with stainless-steel shell equal to Potter-Roemer 3202.

2.16 ROOF MANIFOLD

A. Approved manufacturers are Potter-Roemer, or equal.

B. Cast brass 2-way outlet body equal to Potter-Roemer No. 5840 with No. 4200 gate valves with caps and chains.

C. Control valve shall be non-rising stem Kennedy No.4701 or equal with wall post indicator Kennedy No. 641-13 or floor stand Kennedy No.2945 as required.

2.17 FIRE PUMP

A. Approved manufacturers are Armstrong, Fairbanks Morse, Aurora, Allis Chalmers, and Peerless.

B. The pump shall be of the centrifugal, base-mounted type especially designed and constructed for quiet operation. The size, capacity and model number as shown on the drawings is for bidding purposes only. Final size and capacity to be by fire protection contractor based on hydraulic calculations. The pump shall be listed for fire protection service by Underwriter's Laboratories, Inc.

C. Pump shall be of the horizontally split case double-suction design, making possible complete servicing without breaking piping or motor connections. Motors to pump connection shall be of the flexible coupled type. Pump shall use a stuffing box with five rings of packing. A sealed ring shall be between the second and third rings of packing. The pumps shall be equipped with grease lubricated ball bearings for smooth and quiet operation.

D. Motor shall be drip-proof and shall be especially selected for quiet operation and shall be so stamped. The current characteristics of the motor shall be as shown on the drawings. The horsepower of the motor shall be of such a size as to ensure non-overloading of the motor throughout the capacity range of the pump.

E. Base shall be of a size suitable for the pump, motor, and shaft and shall be constructed of cast iron or welded steel. The pump and driver shall be mounted on a common fabricated steel base and shall be directly connected through flexible coupling.

F. Included with the pump shall be the following accessories:

1. Compound suction gauge.
2. Discharge pressure gauge.
3. Capacity plate.
4. Casing relief valve.
5. Automatic air release.
6. Coupling guard conforming to OSHA specifications.

G. Manufacturer of pumps shall assume unit responsibility and shall provide the services of a factory trained engineer to supervise installation and be available to conduct final field acceptance tests.

2.18 FIRE PUMP CONTROLLER

A. Approved manufacturers: Firetrol, Metron.

B. Controller shall be UL listed as a fire pump controller, combination automatic transfer switch and motor controller.

C. Controller shall comply with NFPA 20.

D. The controller shall be Service Entrance (S.E.) for 480Y/277V electrical utility power service, of the combined manual and automatic type designed for closed transition wye-delta reduced voltage starting of the fire pump motor of horsepower and voltage indicated on plans.

E. Features:

1. Disconnect switch, externally operable.
2. Adjustable setpoint pressure switch.
3. Motor starter energized automatically through pressure switch or manually by an externally operable handle.
4. Minimum running period timer.
5. Pilot lamps:

    a. Power available
    b. Local start
    c. Phase failure
    d. Phase reversal
    e. Pump running

6. Circuit breaker
7. Automatic transfer switch from normal to emergency power, minimum AIC rating to be 65,000Amps, sym or as shown on electrical drawings.
8. Surge protection device to comply with NFPA 70 (NEC) section 695.15.

F. Provide remote panel per NFPA 20 to be installed in the Fire Command Center. Panel to require 120Volt, 1 phase power.

1. Status Indicators:

    a. Pump running.
    b. Loss of line power.
    c. Phase reversal.
    d. Pump failure.
    e. Pump on alternate source.

2. Controls:

    a. Remote pump start switch.

G. Provide remote panel to be installed in a 24 hour monitored security room as designated by the Architect. Panel to require 120Volt, 1 phase power.

1. Status Indicators:

    a. Pump running.
    b. Loss of line power.
    c. Phase reversal.

2.19 JOCKEY PUMP

A. Approved manufacturers are Armstrong, Fairbanks Morse, Aurora, and Allis Chalmers.

B. Provide a pressure maintenance pump to make-up the allowable leakage rate in the system. The pump shall be of size and capacity indicated on the drawings.

C. The jockey pump shall be of the centrifugal or peripheral turbine base-mounted type especially designed and constructed for quiet operation.

D. Jockey pump shall be bronze fitted with flexible coupling between pump and motor. The pump shall use a mechanical rotating type carbon seal. The pump shall be equipped with grease lubricated ball bearings for smooth and quiet operation. Provide a relief valve factory installed with the pump.

E. Motor shall be drip-proof and shall be especially selected for quiet operation and shall be so stamped. The current characteristics of the motor shall be as shown on the drawings. The horsepower of the motor shall be of such a size as to insure non-overloading of the motor throughout the capacity range of the pump.

F. Base shall be of a size suitable for the pump, motor, and shaft and shall be constructed of cast iron or welded steel.

G. The jockey pump shall be controlled by a combination magnetic starter operating in conjunction with a pressure switch. The combination starter shall be equipped with three coil overloads and shall have an “H-O-A” switch in the cover.

2.20 ALARM CHECK VALVES

A. Approved manufacturers are Tyco, Viking, Reliable and Victaulic.

B. Alarm check valve shall provide for the proper functioning of a water motor alarm and/or electric alarm. Valve cover shall allow for replacement of all moving parts without removing the valve from an installed position. Valve shall have flanged or grooved connections. All moving parts shall be brass, bronze or stainless-steel with replaceable neoprene clapper and brass seat. Valve housing shall be tapped to allow installation of alarm accessories, two pressure gauges (one above, and one below the seat) and main drain. Provide all accessories consisting of angle valves, globe valves, orifice restriction, pipe nipples and fittings, retarding chamber, water pressure gauges and circuit closer with two sets of contacts for electric alarms. Valve shall be rated for 175 psi working pressure.

2.21 ALARM DEVICES

A. Equipment necessary to accomplish a transmitted waterflow signal and auxiliary contacts shall be provided. Main shut-off valves shall be electrically supervised. Any tamper-proof switches required for testing the sprinkler system shall be furnished. Alarm devices shall be as manufactured by Potter Electric Signal Company or approved equal.

1. Transmitted Alarm: A transmitted alarm shall be provided for the transmission of waterflow signals to the main fire alarm control panel. Wiring shall be provided in Division 26.

2.22 TEST AND STATUS CONNECTIONS

A. Furnish and install test connection for fire protection system and pipe to appropriate drains.

2.23 MISCELLANEOUS

A. Nameplate data information: The nameplates shall be installed on each main riser and shall include the following design data: building designation, location of remote area, design density, area of application, and system demand (GPM and PSIG at base of riser).

B. Control valve signs: The Contractor shall provide a description sign, minimum dimensions seven (7) inches by nine (9) inches, for every valve in the preaction system which controls water to sprinkler heads. Signs shall be single faced, white letters on a red background, with a space designating who to notify if valve needs to be closed. Signs shall be fastened to each valve with lightweight chain.

C. Miscellaneous signs: These signs for alarm test valves, main drains, auxiliary drains, etc. shall have minimum dimensions of two (2) inches by six (6) inches. Signs shall be single faced, white letters on a red background. Each sign shall be fastened to each valve with lightweight chain.

PART 3 - EXECUTION

3.1 PREPARATION

A. The Contractor shall investigate the conditions affecting the work and shall arrange their work accordingly, providing such fittings, valves, and accessories as may be required to meet such conditions. The Contractor shall field verify all dimensions and conditions governing their work at the building. Materials shall not be fabricated or delivered to the site before the approved submittals have been received by the Contractor.

3.2 GENERAL INSTALLATION

A. Investigate the structural and finish conditions affecting the work and arrange work accordingly, providing such fittings, valves, and accessories as may be required to meet such conditions. The Contractor shall field verify all dimensions and conditions governing their work at the building. Materials shall not be fabricated or delivered to the site before the approved shop drawings and equipment submittals have been received by the Contractor.

B. Entire installation shall be in accordance with approved shop drawings. When unforeseen job site conditions will not permit piping to be installed as shown on the drawings, necessary changes will be made to accomplish a coordinated system without additional cost to the Owner, even though pipe may have been delivered to the site cut to predetermined lengths.

C. Provide gate valves of size and at locations shown on the drawings and any additional valves required by local authorities. Locate all valves where readily accessible. Provide chain wheel operators or permanent ladders for all valves not accessible from the floor. All main line valves shall be electrically monitored or secured with a chain and padlock which will lock the valve in an open position.

D. Provide check valves of size and at location shown on the drawings and any additional check valves that might be required by local authorities.

E. Provide valved test drains as required by NFPA. Pipe test drains to spill on grade whenever possible or to nearest floor drain, or receptor.

F. Make provisions to drain all parts of the piping system.

G. All dry pipe/preaction system piping shall be back pitched (sloped) to drain points. 1/2” per 10’ for branch piping and 1/8” per 10’ for mains. Provide auxiliary drains at all low points.

H. The hydraulic calculations shall be performed in accordance with the requirements of NFPA 13 and 14. The Contractor shall calculate the demand point for the system so that it remains ten (10) percent below the final water supply curve at the connection to the public water system. The demand point for the systems shall include an allowance for the inside and outside hose demand. The basis for the hydraulic calculations shall be determined by a waterflow test performed by the Contractor and acceptable to the Authority Having Jurisdiction.

I. Be responsible for trenching, bedding material, removal of waste material, paving removal and replacement, barricades, and any materials necessary for vehicle and person access across work areas.

J. Bedding shall be well graded non-expansive, non-organic soil containing no rocks over one (1) inch in diameter. There shall be no refuse of corrosive materials in this soil.

K. All bedding and backfill shall be laid and compacted in accordance with Section 23 05 03 and Division 2.

L. Drain termination: all express drains.

3.3 PIPING INSTALLATION

A. Perform the work in a professional workmanlike manner, according to the best practices of the trade. All sprinkler piping must be substantially supported from the building structure and only approved type hangers shall be used. Sprinkler piping in all areas shall be concealed unless otherwise noted on the contract drawings. In those noted locations and in areas with no ceiling, piping shall be installed as high as possible using necessary fittings and auxiliary drains to maintain maximum height. Any deviations found necessary shall be immediately brought to the attention of the Architect. All piping discharging outside (main drains, inspectors test pipes) shall do so on paved surfaces or on splash blocks.

B. All inside piping shall be joined by means of threaded, flanged, flexible gasketed joints, or other approved method. Risers, feed mains, cross mains, and branch lines may be shop welded using approved welding fittings. Welding and brazing shall conform to the standards as set forth in NFPA #13. Welding and torch cutting shall not be permitted as a means of installing or repairing sprinkler system piping on-site.

C. Provide expansion compensation loops at all building expansion joints and other areas where thermal and structural movement may require.

D. Chrome-plated escutcheons shall be provided where exposed piping passes through finished floors, walls, partitions, and ceilings. Secure plates to pipe with set screws or spring clips.

E. Refer to section 23 05 53 for pipe labeling requirements. Piping identification will also be subject to the requirements of applicable codes.

F. Painting: Do not paint piping without AHJ approval.

3.4 AUTOMATIC FIRE SPRINKLER HEAD INSTALLATION

A. All sprinkler heads shall be in alignment, and parallel to ceiling features, walls, etc. The Contractor shall be responsible for the removal and replacement of ceilings, providing ceiling access panels, cutting, patching and restoration of finishes as necessary.

B. Conform to spacing and dimensional constraints indicated by the Architect on the reflected ceiling plans.

C. Sprinkler heads shall be placed minimum of 6” from edge of grid.

D. Sprinkler heads shall be centered within ceiling grid.

3.5 FIRE STOPS AND PENETRATION SEALS

A. All new piping penetrations through fire rated floors and walls shall be sealed with fire resistant sealant to prevent the spread of smoke, fire, toxic gas, and water through the penetration either before, during or after a fire. The fire rating of the penetration seal shall be at least that of the floor or wall into which it is installed.

B. See Section 23 05 03 for requirements.

3.6 FIRE DEPARTMENT CONNECTION INSTALLATION

A. Install check valve and ball drip valve where they will not be subjected to freezing temperatures. The discharge line from the ball drip valve shall be visible.

3.7 FIRE HOSE CABINET INSTALLATION

A. Branch piping to valves must have rigid bracing independent of fire hose cabinet.

3.8 PRESSURE GAUGE INSTALLATION

A. Install pressure gauges at the following locations: street side of check valve; at system side of all control valves. Each gauge connection shall not be less than ¼” and shall be equipped with a shut-off valve and with provision for draining.

B. The required pressure gauges shall be 3” diameter minimum and shall have a maximum limit not less than twice the normal working pressure at the point where installed. They shall be installed to permit removal, and shall be located where they will not be subject to freezing.

3.9 TAMPER SWITCH INSTALLATION

A. Install tamper switches on all control valves.

3.10 FIRE ALARM WIRING

A. All fire alarm and monitor wiring shall be done under the Electrical Division but the proper operation will be the fire protection Contractor’s responsibility.

3.11 FLOOR CONTROL VALVE INSTALLATION

A. Floor control valve shall be a complete assembly consisting of an OS&Y valve, grooved butterfly, or pressure control valve, vane type flow switch with retard chamber, inspector's test and main drain valves. Preassembled UL/FM floor control assemblies equal to Tyco Riser Manifolds are allowed.

B. Pipe discharge from inspector's test and main drain valves through sight glass and orifice to a drain riser.

C. This contractor shall install drain risers to serve floor control valves.

3.12 PIPE TESTING

A. The entire fire protection piping system shall be tested hydrostatically at not less than 200 psi pressure for two hours, or at 50 psi in excess of the maximum static pressure when the maximum static of NFPA pressure is in excess of 150lbs. The hydrostatic test pressure shall be measured at the low point of the individual system or zone being tested. Each complete system (all associated piping and alarms), shall be tested and accepted as a complete unit, with data recorded on an approved "Contractor's Material and Test Certificate". System pressure tests shall be against a blank test flange and not against a valve seat.

B. All tests shall be conducted in the presence of the Architect and Owner. Any system failing to meet the specified test requirements shall be retested at no additional cost, until the test requirements are met.

3.13 FIRE EXTINGUISHERS

A. Install where shown on plans in wall-mounting bracket in accordance with manufacturer's directions.

B. Comply with the requirements of NFPA 10.

3.14 FIRE PUMP TESTING

A. Upon completion of the entire fire pump installation, an operating test shall be made in the presence of the purchaser, local fire officials, pump and controller representatives, and representative of the authority having jurisdiction.

B. It shall be the responsibility of the installing Contractor to make the necessary arrangements for the services of manufacturers' representatives when needed for installation and adjustments of the equipment. In addition, the supplier of the fire pumps and controls shall provide the services of their representatives to instruct Owner's operating and maintenance personnel about the systems.

C. The field acceptance test results shall be as good as the manufacturer's certified shop test characteristic curve for the pump being tested within the accuracy limits of the test equipment.

D. As installed, at operating speed, the pump shall be able to operate at peak load conditions without objectionable heating of the bearings or of the prime mover. The operating pump speed shall be the speed at which the pumping unit would be expected to operate during a fire.

E. During such test:

1. For electric motors at rated voltage (and on A.C. motors at rated frequency), the full load ampere rating shall not be exceeded (except as allowed by the service factor stamped on the nameplate) under any conditions of pump load.
2. For electric motors under conditions of acceptable high or low voltage, the product of the rated voltage (and on A.C. motors at rated frequency) and rated full load current shall not be exceeded (except as allowed by the service factor stamped on the nameplate). The voltage at the motor should not vary more than 5% below or 10% above rated (nameplate) voltage during test.
3. An internal combustion engine shall not show signs of overload or stress and its governor shall properly regulate the speed.
4. A steam turbine shall maintain its speed within the prescribed limits.

F. With discharge outlets open (corresponding to the outlets used in tests at peak load) pump shall be started and brought up to rated speed without interruption due to opening of circuit breaker or other cause.

G. Fire pump controller shall be tested as follows:

1. Manual controllers for pumps shall be put through not less than ten complete operations.
2. Automatic controllers shall be put through not less than ten automatic and ten manual operations.
3. A running interval of at least five minutes at full speed shall be allowed before repeating the starting cycle.
4. Automatic operation of the controller shall start the pump from all the provided starting features, such as pressure switches, deluge valves, etc.
5. Electric motor shall attain rated speed within ten seconds.

H. The pump shall be in operation not less than one hour (total time) during the foregoing test.

3.15 MAINTENANCE AND OPERATIONAL INSTRUCTIONS

A. System description, system theory of operation, and system final inspection and acceptance documents of the completed system (as built) shall be submitted in a bound book as described in Division 1. The maintenance manuals and instructions shall include a brief description of the type of system installed, routine-type maintenance work defined by step-by-step instructions that should be performed to ensure long life and proper operation, and the recommended frequency of performance. The instructions shall also include possible trouble spots with diagnosis and correction of each. The theory of operation brochures shall describe the function of each component or subassembly in block-diagram type presentation to a degree that a craftsman will understand the system well enough to operate and maintain it.

3.16 PROTECTION

A. Protect all apparatus, fixtures, materials, equipment, and installations so as to prevent damage as a result of new work. The Contractor shall replace at their own expense any item, which is marred, defaced, broken, or damaged in any way, prior to the date of Notice of Acceptance.

END OF SECTION

SECTION 21 13 19 - PREACTION SUPPRESSION SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including the General Conditions of the Contract and Supplementary General Conditions and Division 1 - General Requirements, apply to work of this Division 21.

1. Section 23 05 02 - Basic Mechanical Requirements.
2. Section 21 13 00 - Fire Protection.
3. Electrical work as covered under Division 26 - 28 - Electrical.

1.2 DESCRIPTION OF WORK

A. Provide new double interlock preaction suppression systems as indicated on the Drawings and specified herein.

B. It is the intent of this Specification for the Contractor to provide complete hydraulically designed preaction sprinkler systems for the areas indicated in these Specifications and shown on the Contract Drawings. Furnish all design, material, and labor to complete the Contract within the intent of these Specifications and Contract Drawings even though each and every item necessary is not specifically mentioned or shown.

1.3 QUALITY ASSURANCE

A. Referenced Standards:

1. The new system shall be in accordance with the latest revisions of the National Fire Codes and specifically the National Fire Protection Association Standards 13 and 24 Standard products shall be listed by Underwriters Laboratories or approved by Factory Mutual and bear their label.

B. Qualifications:

1. The system shall be designed and installed by an experienced firm regularly engaged in the installation of automatic fire protection systems. The Contractor shall have a minimum of five (5) years of experience in the design, installation, and testing of automatic fire protection systems. Experience shall include projects of similar type, size and complexity.

PART 2 - PRODUCTS

2.1 GENERAL

A. Unless otherwise shown on the Contract Drawings or specified herein, all materials, valves, and equipment used in the installation of the fire protection system shall be U.L. listed or F.M. approved, and shall be new and of the latest design of the manufacturer.

2.2 DELUGE VALVE

A. The deluge valve shall be a quick opening flood valve kept closed by a water pressure differential and activated by a manual, hydraulic, or electrical release system. The valve shall be hydrostatically tested to 350 psi and have a 175 psi working pressure.

2.3 DEHYDRATOR

A. The dehydrator shall have a see-through plastic shell desiccant container, filled with disposable silica gel crystals. The maximum air flow rate shall be 10 cfm. The drying capability shall be 5500 cfm or air to low dew point before desiccant must be changed.

2.4 PRESSURE OPERATED RELIEF VALVE

A. The P.O.R.V. shall be cast bronze construction, have a working pressure of 175 psi and operate at 5 to 7 psi. Once tripped it shall maintain a positive vent.

2.5 DIAPHRAGM BYPASS

A. The diaphragm bypass shall be a pressure sensitive diaphragm valve with 3 chambers. It shall be of cast bronze construction, hydrostatically tested to 350 psi with a working pressure of 175 psi.

2.6 EMERGENCY RELEASE (HYDRAULIC)

A. This emergency release shall operate as a local, manual trip for the hydraulic preaction system and shall be located at the riser. It shall consist of a quick-opening, level-operated ball valve mounted in a steel enclosure. The enclosure shall have a full-opening door with a piano type hinge.

2.7 AIR SUPERVISORY SWITCH

A. The air supervisory switch shall be protected in a metal, watertight (NEMA 4) housing. The switch shall be 24-Volt D.C. single pole double throw snap action (N.O./N.C.) with an adjustable range of 3 to 90 psi and a nonadjustable actuation differential of 0.5 to 8.0 psi.

2.8 SOLENOID VALVE

A. The electric solenoid valve shall be a 24-Volt D.C., normally closed, two (2) way type with one (1) inlet and one (1) outlet. It shall be a packless internal pilot actuated valve suitable for use with water.

2.9 PRESSURE SWITCH

A. The pressure switch shall be protected in a metal, watertight (NEMA 4) housing. The switch shall be 24-Volt D.C. single pole double throw snap action (N.O./N.C.) with an adjustable range of 5 to 15 psi and an actuation differential of 0.2 to -2.0 psi.

2.10 RELEASE CONTROL PANEL

A. The release control panel shall incorporate a supervised 24-Volt D.C. circuitry to operate an electric release (solenoid valve), in the release line of the preaction system. It shall be capable of providing supervision for detectors and other devices and providing local and remote alarms and trouble alarms. The panel shall be compatible with smoke detectors. The unit shall be provided with trouble horn, alarm lights, and control switches and be factory wired. An electric emergency release button shall be provided. Panels shall be located in an approved location.

2.11 AIR MAINTENANCE DEVICE

A. An air compressor shall be provided and sized to establish total regained air pressure within 30 minutes throughout the entire system. Air Compressor and related trim shall be furnished and installed to provide dry air to the system.

PART 3 - EXECUTION

3.1 PREPARATION

A. The Contractor shall investigate the structural and finish conditions affecting the work and shall arrange their work accordingly, providing such fittings, valves, and accessories as may be required to meet such conditions. The Contractor shall field verify all dimensions and conditions governing their work at the building. Materials shall not be fabricated or delivered to the site before the approved shop drawings and equipment submittals have been received by the Contractor.

3.2 DESIGN

A. This system is a double interlock preaction system. The electrical detector circuit must actuate and a sprinkler must fuse before water will enter the system. Activation of one without the other shall only initiate an alarm. When any detector in that circuit actuates, the release control panel actuates an electric alarm. If a sprinkler head fuses, the system piping or a sprinkler is damaged, the loss in air pressure shall open the diaphragm bypass and actuate the low-pressure switch and alarm. When both detection systems actuate simultaneously a signal shall be sent from the control panel to the release trim solenoid valve and the deluge valve shall open. Opening the emergency release shall open the deluge valve and allow water to enter the system immediately.

B. Detector types and locations shall be furnished under Division 26. Each zone shall have at least two such independent detectors.

END OF SECTION

SECTION 21 90 00 - FIRE SUPPRESSION SYSTEM PROJECT CLOSEOUT

PART 1 - GENERAL

1.1 REFER TO RELATED SECTIONS

A. Section 23 90 00 – Project Closeout

PART 2 - PRODUCTS – NOT USED

PART 3 - EXECUTION – NOT USED

END OF SECTION

This page is intentionally left blank.

SECTION 22 00 00 - BASIC PLUMBING REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes general administrative and procedural requirements, as well as the project general requirements for the job.

1.3 PROJECT GENERAL REQUIRMENTS

A. The intent of the drawings and specifications is to provide complete and properly functioning building systems. The Contractor shall provide all labor and material necessary to achieve such ends.

B. The plans and specifications are to be considered complimentary. In case of discrepancies, the most stringent shall apply, as determined by the Engineer of Record.

C. Consider flow diagrams and detail as part of the Contract Documents. Provide equipment, valves, piping and other accessories shown on flow diagrams and details as if they were shown on the floor plans.

D. Provide minor items, accessories or devices as necessary for completion and proper operation of systems, whether or not they are specifically indicated by specifications or drawings.

E. Work that is installed in a method not in accordance with the contract documents, as determined by the Engineer, shall be removed at no additional cost or time penalty to the Owner.

F. The Contractor shall thoroughly examine the contract drawings, visit the site and verify, in the field, all existing conditions before submitting a bid. By the submission of a bid, the Contractor shall acknowledge acceptance of this plan set as an adequate definition of the scope of work and extra cost claims based on inadequacy of plans shall not be considered. No consideration or allowance shall be granted for failure to investigate existing conditions or misunderstandings of the contractual requirements.

G. Definitions: Refer to the drawings and other sections of these specifications for definitions not included below:

1. Contract Documents": Complete project specifications and drawings.
2. "Provide": Furnish and install.
3. "Furnish": Supply and deliver to the project site.
4. "Install": Erect in place.
5. "Concealed": Hidden by walls and/or ceilings.
6. "Exposed": Visible to view.
7. "Indicated": Shown in the contract documents.

H. The Contractor shall provide all equipment and materials in accordance with the best engineering practice. Follow the manufacturer's published installation instructions and provide all required auxiliary items. Show all required items on layout drawings.

I. All equipment provided shall be new and the current models for which technical support from the manufacturer and replacement parts are available.

J. All equipment supplied shall be suitable for the purpose intended. All manufacturers shall have had similar products in service for a minimum of three (3) years.

K. Coordinate work and equipment of all sections within Division 22 with work and equipment of other Divisions, to assure complete and satisfactory installation.

L. Perform work, such as: excavation, backfill, concrete, flashing and fire proofing required by Division 22 in compliance with requirements of other applicable Divisions of the specifications.

M. The Contractor shall install all piping parallel to or perpendicular to building walls in a neat workmanlike manner, unless specifically noted. Provide all support steel, hangers, vibration isolation and accessories necessary for equipment per manufacturer's recommendations. Do not support any ceilings or other building structure from piping or appurtenances. Do not allow piping or appurtenances to come into direct contact with building walls or floors. Do not support piping or appurtenances from installed ductwork, other piping, raceways, circuitry, etc. Each installed utility shall be individually supported from the building structure.

N. Where access panels are required for equipment service access, the Contractor shall coordinate final access panel location with equipment location. Access panel sizes shall sufficient to allow service as indicated in the manufacturer's published operation and maintenance manuals.

O. The Contractor shall carefully coordinate the openings in the mechanical room as to allow the rigging of the equipment. The air handling unit fans, return air fan, pumps and other equipment shall be shipped to the site in sections that shall fit in the openings provided.

P. Field direction that is perceived as different or contradictory to the contract documents shall not relieve the Contractor from complying with the contract documents.

1.4 REPAIR WORK INCLUDED

A. Repair damage to work installed under Division 22 or to work of others, caused by neglect on the part of the Division 22 Contractor at own expense and to the satisfaction of Architect.

1.5 UNFINISHED OR FINISHED AREA, GENERAL DEFINITION

A. Finished area shall be defined as a space with walls either tiled, plastered, covered or painted except certain concrete or concrete block foundation walls below grade.

B. Run vertical piping through finished spaces in chases or concealed in walls or partitions.

C. Conceal all piping and conduit above ceilings, where there are ceilings in finished areas. Where indicated "at ceiling", piping shall be exposed below the ceiling.

D. Areas where bottoms of floor or roof slabs serve as finished ceilings shall also be considered as finished areas.

E. Unfinished areas shall be defined as spaces without wall finish (with or without ceilings).

F. Where in doubt as to classification of any space(s), obtain written clarification from Architect before roughing-in.

1.6 CONTRACT DRAWINGS

A. Drawings indicate arrangements, approximate sizes and relative locations of major apparatus, equipment, devices and services provided as part of the Work.

B. Check and compare layout of equipment indicated on drawings against all drawings, specifications of all Divisions, and exact locations determined using approved shop drawings of such equipment.

C. Where physical interference occurs, consult with the Engineer and prepare dated, dimensioned drawings correcting such interferences. Submit to the Engineer for review of such drawings.

D. Do not scale drawing to determine working dimension. Such measurements shall be taken from figured dimensions.

E. Do not scale drawing to determine working dimension. Such measurements shall be taken from figured dimensions.

1.7 LOCATIONS OF FIXTURES

A. Fixtures, equipment, sleeves, piping and connections thereto shall be located as directed by Architect and to avoid conflicts with work of others.

B. When so directed, by Architect, prepare 1/4-inch scale drawings to indicate and dimension, size, and locations of all sleeves in slabs, partitions, foundation wall, beams and/or columns.

C. Obtain approval of Architect of above drawings before continuing with work.

1.8 EQUIPMENT DEVIATIONS FROM DESIGN

A. Dimensions and ratings of equipment specified or indicated on drawings establish desired outlines and characteristics of such equipment. Minor deviations will be permitted to allow manufacturers specified to bid on their nearest stock equipment, providing that equipment equals or exceed basic performance conditions indicated.

B. Manufacturer's catalog or model numbers and types mentioned in specifications or indicated on drawings are intended to be used as guides and shall not be interpreted as taking precedence over specific ratings or duty called for or shown, which modify stipulations in such catalog. Verify duty specified with particular characteristics of equipment to be submitted for approval, and submit only items which comply with specification requirements.

C. Where equipment furnished differs in physical character from that specified or indicated or where equipment substituted at request of Division 22 Contractor, which is acceptable to Owner and Architect, requires increased services or facilities to be provided, pay costs for such services and other modifications that may be required to accommodate substituted equipment.

1.9 SUBSTITUTIONS

A. Comply with "Conditions of Contract", and SECTION 016000.

B. Substituted equipment or equipment options, where permitted and approved, must fit within the allowable physical space and satisfy all manufacturer-required service clearances.

C. Whether approved or not, the Contractor shall replace substituted equipment that cannot fit into the allowable space, at his own expense.

D. Contractor shall make any modifications to related systems, required as a result of substitutions, at his own expense.

1.10 GUARANTEE AND CERTIFICATION

A. All work, equipment and materials shall be guaranteed and certified to be free from defects and leaks for not less than one year following date of beneficial use, unless specified for a longer period elsewhere.

B. Defective work, equipment and/or materials, and any resulting damage to work of other divisions, shall be repaired or replaced, as directed, for duration of stipulated guarantee period.

1.11 DELIVERY, STORAGE, AND HANDLING

A. Refer to other divisions of this specification for location of Contractor storage and staging area.

B. Deliver all materials with factory-applied end closures. Maintain end closures through shipping, storage, and handling to prevent pipe end damage and prevent entrance of dirt, debris, and moisture.

C. Protect materials from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor, if stored inside.

D. Protect flanges, fittings, and piping specialties from moisture and dirt.

1.12 SEQUENCING AND SCHEDULING

A. Coordinate mechanical equipment installation other building components. Refer to Section 01 32 16 requirements.

B. Arrange for chases, slots, and openings in building structure during progress of construction to allow for plumbing work installations.

C. Coordinate the installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

D. Sequence, coordinate, and integrate installations of mechanical materials and equipment for efficient flow of the Work. Coordinate installation of large equipment requiring positioning prior to closing in the building.

E. Coordinate connection of electrical services.

F. Coordinate connection of mechanical systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies.

G. Coordinate requirements for access panels and doors where mechanical items requiring access are concealed behind finished surfaces.

H. Coordinate installation of identifying devices after completing covering and painting where devices are applied to surfaces. Install identifying devices prior to installing acoustical ceilings and similar concealment.

1.13 REFERENCED ORGANIZATIONS AND CODES

A. The following list of abbreviations are utilized within the specifications and are provided as a reference:

1. AABC - Associated Air Balance Council.
2. ADA - American Disability Act.
3. AGA - American Gas Association.
4. ANSI - American National Standards Institute.
5. ASHRAE - American Society of Heating, Refrigerating and Air Conditioning Engineers.
6. ASME - American Society of Mechanical Engineers.
7. ASPE - American Society of Plumbing Engineers.
8. ASSE - American Society of Sanitary Engineering
9. ASTM - American Society for Testing and Materials.
10. AWWA - American Water Works Association.
11. CS - Commercial Standard.
12. CSA - Canadian Standards Association.
13. FM - Factory Mutual Global
14. HI - Hydraulic Institute.
15. IBC - International Building Code.
16. IBR - Institute of Boiler and Radiator Manufacturers.
17. IECC - International Energy Conservation Code.
18. IEEE - Institute of Electrical and Electronics Engineers.
19. MSSP - Manufacturers Standards Society of the Valve and Fittings Industry.
20. NEC - National Electrical Code.
21. NEMA - National Electrical Manufacturers Association.
22. NFPA - National Fire Protection Association.
23. NSF - NSF International
24. OSHA - Occupational Safety and Health Administration.
25. PHCC - National Standard Plumbing Code Illustrated.
26. SMACNA - Sheet Metal and Air Conditioning Contractors National Association.
27. TEMA - Tubular Exchanger Manufacturers Association.
28. UL - Underwriters' Laboratories.

1.14 OUTAGES

A. For all work requiring an outage, the contractor shall submit an outage request to the owner and architect in enough time to allow a 3 week review or as required by Div 1. The outage request shall include as a minimum:

1. System(s) effected
2. Proposed isolation points
3. Start and Duration of outage
4. Contractor contact person
5. Emergency procedures
6. Method of procedure

B. All mechanical outages, which will interfere with the normal use of the building in any manner, shall be done at such times as shall be mutually agreed upon by the contractor and the Owner.

C. The contractor shall include in his price the cost of all premium time required for outages and other work, which interferes with the normal use of the building, which will be performed.

D. The operation of valves or switches; required to achieve an outage must be accomplished by the owners personnel only. Prospective subcontractors under this section are cautioned that the unauthorized operation of valves, power switches, or other control devices by their personnel can result in extremely serious consequences for which the contractor will be held accountable.

1.15 CUTTING, WELDING, BURNING

A. Before the Contractor commences any cutting, welding, burning, brazing or pipe sweating, the Contractor shall obtain a hot work permit from the Owner.

B. The hot work permit copy shall remain on the job site at the hot work location until such work is completed.

1.16 PERFORMANCE REQUIREMENTS

A. Contract drawings are generally diagrammatic and do not indicate all offsets, fittings, transitions, access panels and other specialties required.

B. Furnish and install all items as may be required to fit the work to the conditions encountered.

C. Arrange piping, equipment and other work generally as shown on the contract drawings, providing proper clearances and access.

D. Where departures are proposed because of field conditions or other causes, prepare and submit detailed shop drawing submittal for approval in accordance with Submittals specified below.

E. The Owner may make reasonable changes in location of equipment piping and equipment up to the time of rough-in or fabrication at no charge and with no time extension.

F. Equipment submitted that is not basis of design must meet all specified/scheduled performance criteria. No additional compensation shall be made to the Contractor if substituted equipment does not meet performance criteria.

1.17 MATERIALS AND EQUIPMENT

A. The contract drawings and system performances have been designed on the basis of using the particular manufacturer’s products specified or scheduled on the contract drawings.

B. All proposed substitutions shall be reviewed by the Engineer. The determination of equal products to the prototype shall be at the sole discretion of the Engineer.

C. Products of other manufacturer’s listed in the specification shall be permitted provided as follows:

1. Product shall meet the specifications. If the contractor intends to use a product or equipment not explicitly defined in the project specifications, they shall submit to Substitution Request to the Owner/Architect/Engineer in writing for review and approval.
2. Any substitutions for the approved product shall require the contactor to make all required changes to all associated trades to accommodate the substitution at no cost or time impact to the project. All substitutions shall be provided with a benefit to the Owner in the form of

a credit, reduction in construction schedule, or other advantage approved by the Owner. Substitutions submitted for review without a credit shall be returned "Rejected/Resubmit".

3. All changes shall be made, without additional cost to the Owner or effort by the design team. The Contractor shall be responsible to provide all adjustments for deviations, such that the final installation is complete and functions as the basis of design product is intended. For equipment substitutions, the Contractor shall make all required accommodations to utilize unit selected, at no additional cost to Owner including but not limited to:

    a. Electrical modifications including circuit breaker fuse, disconnect switch, conduit and wire size.
    b. Structural modifications.
    c. Providing National Electrical Code (NEC) and Authority Having Jurisdiction (AHJ) required service clearances.
    d. Space requirements with all other trades if physical dimensions are different than shown in the construction documents.

D. Products with dimensions or other characteristics different from the basis of design product that render their use impractical or cause functional fit, access, or connection problems, shall not be acceptable.

E.

1.18 SUBMITTALS

A. General: Follow the procedures specified in Division 1 Section "Submittals" except as modified below.

B. The purpose of the submittal process is to show, via products, shop drawings, performance data, and calculations, how the Contractor shall conform to the contract documents.

C. Shop drawing review by the Engineer of Record is only for the limited purpose of checking for conformance with the information given in the construction documents. Review is not conducted for the purpose of determining the accuracy of or completeness such as dimensions or quantities.

D. Contractor shall provide a submittal log within thirty (30) days of contract award detailing each submittal item, anticipated submittal date, actual submittal date, submittal status, submittal number and approved date of each original and resubmittal package. This may be done electronically if the content and format are approved by Engineer. Payment will be withheld for any mobilization, project initiation and or start-up cost until same is approved.

E. The Contractor shall submit shop drawings, fabrication drawings, product data and receive approval from the Engineer of Record prior to construction or ordering of same.

F. Approval by Engineer of Record does not absolve Contractor of code or Authority Having Jurisdiction (AHJ) requirements.

G. Submittals must clearly indicate the specific products, accessories and where they shall be used on this project. Submittals that do not contain the above information shall be rejected.

H. Submittals shall be reviewed by the Contractor and bear his stamp that the submittal meets the contract documents. Submittals that are not stamped shall be rejected as they will not have proof that the Contractors have adequately reviewed the submittal for compliance with the contract documents.

I. Submittals shall be reviewed not more than two (2) times. If the Contractor fails to submit shop drawings that are approved by the Engineer of Record within the first two attempts, he shall be back charged at a current rate of the Engineer of Record's hourly contact rate for all subsequent reviews.

J. Return of an 'Make Corrections Noted' submittal does not require resubmission to the Engineer of Record for re-review but rather acknowledgement in writing from the Contractor that they will make the corrective actions noted prior to construction and include them in the Record Documents.

K. The Engineer of Record reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.

L. Submit samples of color, lettering style, and other graphic representation required for each identification material and device.

M. Shop drawings detailing fabrication and installation for all supports and anchorage for materials and equipment shall be provided with the specific piece of equipment.

N. Welder certificates signed by Contractor certifying that welders comply with requirements specified under the "Quality Assurance" Article.

O. All re-submittals must come with narrative on the Contractor's company letterhead responding to the Engineer of Record's review comments and describing changes made.

P. LEED Submittals:

Q. Product data for Credit IEQ 4.1: For adhesives and sealants applied within the building waterproofing envelope, documentation including printed statement of VOC content in g/L.

R. Product data for Credit IEQ 4.2: For paints and coatings applied within the building waterproofing envelope, documentation including printed statement of VOC content in g/L.

1.19 COORDINATION DRAWINGS

A. Coordination drawings shall be submitted as an "Informational Submittal." Informational Submittals shall be written and graphic information and physical samples that do not require Architect's responsive action. Submittals will be reviewed for conformance with specified requirements. Submittals may be rejected for not complying with these specified requirements.

B. Prepare coordination drawings [and updated BIM model] in accordance with Division 1 to a scale of 1/4"=1'-0" or larger; detailing major elements, components, and systems of plumbing equipment and materials in relationship with other systems, installations, and building components. Coordination drawings shall include the specific equipment proposed by the Contractor and not just generic or prototype equipment. Indicate locations where space is limited for installation and access and where sequencing and coordination of installations are of importance to the efficient flow of the Work, including (but not necessarily limited to) the following:

C. Contractor shall coordinate with all other trade contractors to provide a single, comprehensive set of documents that reflect actual fabrication and installation of project components and systems.

D. Indicate the proposed locations of piping, valves, equipment, and materials. Include the following:

1. All sizes, shapes, connection points, service clearances, weights, support points of each proposed piece of equipment and the structure, adjacent equipment.
2. Planned piping layout, including valve and specialty locations and valve stem movement.
3. Clearances for installing and maintaining systems and components.
4. Clearances for servicing and maintaining equipment, and space for equipment disassembly required for periodic maintenance.
5. Equipment connections and support details.
6. Exterior wall and foundation penetrations.
7. Fire-rated wall and floor penetrations.
8. Sizes and location of required concrete pads and bases.
9. Access doors.

E. Indicate scheduling, sequencing, movement, and positioning of large equipment into the building during construction.

F. Prepare floor plans, elevations, and details to indicate penetrations in floors, walls, and ceilings and their relationship to other penetrations and installations. Show all wall mounted access doors for mechanical devices.

G. Prepare reflected ceiling plans to coordinate and integrate installations, air outlets and inlets, light fixtures, communication systems components, cable trays, sprinkler heads, access doors and other ceiling-mounted items.

H. Provide Information Submittals of drawings for the work that shall be solely for the benefit of the Contractor and shall not be reviewed including:

1. Sleeve drawings.

1.20 OPERATION AND MAINTENANCE MANUALS

A. Prepare operations and maintenance manuals in accordance with Division 1 Section "Project Closeout." In addition to the requirements specified in Division 1, include the following information for equipment items:

1. Periodic maintenance schedule.
2. Parts list.
3. Parts supplier listing.
4. Service diagrams.

B. Operating and maintenance instructions shall be presented to the Engineer of Record bound in three ring binders, tabbed by system and as electronic PDF on a flash drive, before the pre-final review of construction.

C. List of systems and equipment requiring service manuals.

D. Description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and commercial numbers of replacement parts.

E. Manufacturer's printed operating procedures to include start-up, run-in, and routine and normal operating instructions; regulation, control, stopping, shutdown, and emergency instructions; and summer and winter operating instructions.

F. Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions.

G. Servicing instructions and lubrication charts and schedules.

H. Systems and equipment test reports.

I. All warranties for equipment installed on this project.

J. Contractor's workmanship and materials warranty.

K. Start-up report in readable legible fashion.

L. Final TAB report.

M. Water treatment and/or sterilization start-up and monthly reports.

1. Copy of AJU inspection report including final approval.
2. Copy of third party inspection reports.

1.21 UNDERWRITER'S LABORATORY (UL) REQUIREMENTS

A. All equipment containing electrical components and provided as part of the mechanical specifications shall bear the Underwriter's Laboratory (UL) label, as a complete packaged system.

B. Equipment not provided with a UL label shall be tested in the field, certified and provided with a UL label at the installer's expense.

C. Field testing shall be performed by a testing agency approved by the authority having jurisdiction.

1.22 FIRE SAFE MATERIALS

A. Unless otherwise indicated, materials shall conform to UL, NFPA or ASTM standards for fire safety with smoke and fire hazard rating not exceeding flame spread of twenty five (25) and smoke developed of fifty (50).

1.23 COLOR SELECTION

A. Color of finishes shall be as selected by the Architect. Submit colors of factory finished equipment for acceptance prior to ordering.

1.24 VARIANCES

A. Where variances occur between the drawings and specifications or within either document itself, the item or arrangement of better quality, greater quantity or higher cost shall be included in the contract price. The Engineer of Record shall decide on the item and manner in which the work shall be provided.

1.25 STANDARD OF QUALITY

A. Provide materials that comply with quality, style and sizes specified and shown on Drawings.

B. Manufacturer's names and model numbers may be stated in contract documents for the purpose of establishing standards of quality, style, size and type, and shall not be construed to

exclude equipment or materials of other acceptable manufacturers, subject to compliance with contract requirements.

C. Where a specific manufacturer is specified, provide specified item of product of one of other acceptable manufacturer where permitted, provided that alternate item conforms in all respects to Indicated requirements.

1. Consideration will not be given to claims that another manufacturer's item meets performance requirements with lesser construction.
2. Performance as delineated on contract drawings and in specifications shall be interpreted as minimum performance requirements.
3. Provide documentation that compares each specific characteristic of the specified manufacturer's product to that of the proposed "acceptable manufacturer's" product.

1.26 GUARANTEE/WARRANTY:

A. All materials, equipment, etc. provided by the Contractor shall be guaranteed and warranted to be free from defects in workmanship and materials for a period **of two (2)** years after date of substantial completion and acceptance of work by the Owner or as required by Division. 1. Any defects in workmanship, materials, or performance which appear within the guarantee period shall be corrected by the Contractor without cost to the Owner, within a reasonable time. In default thereof, Owner may have such work done and charge the cost of same to the Contractor. Any special warranties shall be as detailed in relevant specification sections. Manufacturer's standard warranties shall not absolve Contractor of specification requirements.

PART 2 - PRODUCTS

2.1 CONCRETE AND MASONRY WORK

A. Concrete: 3,500 psi compressive strength after twenty-eight (28) days.

2.2 GROUT

A. Non-shrink, Nonmetallic Grout: ASTM C 1107, Grade B.

B. Characteristics: Post hardening, volume adjusting, dry, hydraulic cement grout, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.

C. Design Mix: 5000-psi (34.50MPa), twenty-eight (28) day compressive strength

D. Packaging: Premixed and factory-package.

2.3 ACCESS DOORS AND PANELS

A. For all access doors and panels located within the secure interior perimeter, refer to section 11 19 08 "security access doors and frames." For all access door located outside the secure interior perimeter, including the maintenance building, refer to section 08 31 00 "access doors and panels."

B. All items requiring access for operation or maintenance, including but not limited to equipment, devices, valves, and switches shall have an access door, whether indicated on the drawings or not.

PART 3 - EXECUTION

3.1 ROUGH-IN

A. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected.

B. Refer to equipment specifications included in the mechanical specifications for equipment rough in requirements.

3.2 INSTALLATIONS

A. General: Sequence, coordinate, and integrate the various elements of mechanical systems, materials, and equipment. Comply with the following requirements:

1. Coordinate plumbing systems, equipment, and materials installation with other building components.
2. Verify all dimensions by field measurements.
3. Arrange for chases, slots, and openings in other building components during progress of construction, to allow for plumbing installations.

B. Coordinate the installation of required supporting devices and sleeves to be set in poured-in-place concrete and other structural components, as they are constructed.

C. Sequence, coordinate, and integrate installations of mechanical materials and equipment for efficient flow of the Work. Give particular attention to large equipment requiring positioning prior to closing in the building.

D. Where systems, materials and equipment are intended for overhead installation, and where mounting heights are not detailed or dimensioned, install systems, materials, and equipment to provide the maximum headroom possible. Notify the Owner prior to installation when headroom is less than 7'-6".

E. Coordinate connection of mechanical systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies. Provide required connection for each service.

F. Install systems, materials, and equipment to conform with approved submittal data, including coordination drawings, to greatest extent possible. Conform to arrangements indicated by the Contract Documents, recognizing that portions of the Work are shown only in diagrammatic form. Where coordination requirements conflict with individual system requirements, refer conflict to the Architect.

G. Install systems, materials, and equipment level and plumb, parallel and perpendicular to other building systems and components.

H. Install plumbing equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. As much as practical, connect equipment for ease of disconnecting, with minimum of interference with other installations. Extend grease fittings to an accessible location.

I. Install access panel or doors where units are concealed behind finished surfaces. Access panels and doors are specified in the Division 8 specifications.

J. Install systems, materials, and equipment giving right-of-way priority to systems required to be installed at a specified slope.

K. The contractor shall confirm that all pressure vessels are installed in full compliance with the requirements of the state inspector's office for boilers and pressure vessels.

3.3 CUTTING AND PATCHING

A. General: Perform cutting and patching in accordance with Division 1 Sections. In addition to the requirements specified in Division 1, the following requirements apply:

1. Protection of Installed Work: During cutting and patching operations, protect adjacent installations.

B. Perform cutting, fitting, and patching of plumbing equipment and materials required to:

1. Uncover Work to provide for installation of Out-of-Sequence Work.
2. Remove and replace defective Work.
3. Remove and replace Work not conforming to requirements of the Contract Documents.
4. Remove samples of installed Work as specified for testing.
5. Commission the Work.

C. Upon written instructions from the Architect, uncover and restore Work to provide for Architect/Engineer observation of concealed Work.

D. Cut, remove and legally dispose of selected plumbing equipment, components, and materials as indicated, including but not limited to removal of piping, plumbing fixtures and trim, and other plumbing items made obsolete by the new Work.

E. Protect the structure, furnishings, finishes, and adjacent materials not indicated or scheduled to be removed.

F. Provide and maintain temporary partitions or dust barriers adequate to prevent the spread of dust and dirt to adjacent areas.

G. Patch finished surfaces and building components using new materials specified for the original installation and using experienced Installers. Installers' qualifications refer to the materials and methods required for the surface and building components being patched.

1. Refer to Division 1 Section "Definitions and Standards" for definition of "Experienced Installer".

3.4 PAINTING AND FINISHING

A. Refer to Division 9 Section "Painting" for field painting requirement.

B. Damage and Touch Up: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

C. Do not paint manufacturer's labels or tags.

3.5 CONCRETE BASES

A. Construct concrete equipment bases of dimensions indicated, but not less than four (4) inches larger than supported unit in both directions. Follow supported equipment manufacturer's setting templates for anchor bolt and tie locations. Use 3000-psi, twenty-eight (28) day compressive strength concrete and reinforcement bars as specified in the architectural specifications. Housekeeping pads shall be 4-inches in height except for air handling units. For air handling units, housekeeping pad shall be at a depth to allow p-trap installation per manufacturer's requirements and for service access beneath installed p-trap.

3.6 ERECTION OF METAL SUPPORTS AND ANCHORAGE

A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor mechanical materials and equipment.

B. Field Welding: Comply with AWS D1.1 "Structural Welding Code - Steel"

3.7 ERECTION OF WOOD SUPPORTS AND ANCHORAGE

A. Cut, fit, and place wood grounds, nailers, blocking, and anchorage to support and anchor mechanical materials and equipment.

B. Select fastener sizes that shall not penetrate members where opposite side shall be exposed to view or shall receive finish materials. Make tight connections between members. Install fasteners without splitting wood members.

C. Attach to substrates as required to support applied loads.

3.8 GROUTING

A. Install nonmetallic non-shrink grout for mechanical equipment base bearing surfaces, pump and other equipment base plates, and anchors. Mix grout according to manufacturer's printed instructions.

B. Clean surfaces that come into contact with grout.

C. Provide forms for placement of grout, as required.

D. Avoid air entrapment when placing grout.

E. Place grout to completely fill equipment bases.

F. Place grout on concrete bases to provide a smooth bearing surface for equipment.

G. Place grout around anchors.

H. Cure placed grout according to manufacturer's printed instructions.

3.9 PENETRATION OF WATERPROOF CONSTRUCTION

A. Coordinate the work to minimize penetration of waterproof construction, including roofs, exterior walls and interior waterproof construction.

B. Furnish and install drains, curbs, vent assemblies, sleeves, flashing, etc. specifically designed for application to the particular construction. Install system in accordance with the roofing manufacturer's instructions.

3.10 EXCAVATION AND BACKFILLING

A. General:

B. Perform all necessary excavation, for installation of work as part of the mechanical specifications in accordance with the architectural specifications.

3.11 CLEANING AND FINISHES

A. Clean surfaces prior to application of insulation, adhesives, coating, and paint.

B. Provide factory applied finish where specified.

C. Protect all finishes, and restore all finishes to their original condition if damaged as a result of work installed as part of the mechanical specifications.

D. Remove all construction marking and writing from exposed equipment, piping and building surfaces.

3.12 PROTECTION OF WORK

A. Protect work, material and equipment from weather and construction operations before and after installation.

B. Properly store and handle all materials and equipment.

C. Cover temporary openings in piping and equipment to prevent the entrance of water, dirt, debris, and other foreign matter.

3.13 ELECTRICAL REQUIREMENTS

A. Unless otherwise indicated, furnish and install control and interlock wiring for the equipment furnished under this division. In general, power wiring and motor starting equipment shall be provided as specified in the electrical specifications.

B. Where the electrical requirements of the equipment furnished differ from the provisions made in the electrical specifications, make the necessary allowances as part of the mechanical specifications.

C. Where no electrical provisions are included in the electrical specifications, include all necessary electrical work as part of the mechanical specifications.

D. All electrical work performed, as part of the mechanical specifications shall be provided in accordance with the electrical specifications.

3.14 PROVISIONS FOR ACCESS

A. Furnish and install adequate access to all HVAC and plumbing components. The following list shall be used as a guide only:

1. Equipment.
2. Valves.
3. Filters.
4. Controls.
5. Cleanouts.
6. Traps.

B. Access shall be adequate as determined by the Architect.

C. Refer to contract drawings where access panels have been specifically located.

D. Provide additional access panels for adequate access to equipment and components as indicated in paragraph ‘A’ above.

E. Where access is by means of lift out ceiling tiles or panels mark each access panel, using small color coded or numbered tabs. Provide an index chart for identification. Place markers in corner of tile.

3.15 PENETRATION OF WATERPROOF CONSTRUCTION

A. Coordinate the work to minimize penetration of waterproof construction, including roofs, exterior walls and interior waterproof construction.

B. Furnish and install drains, curbs, vent assemblies, sleeves, flashing, etc. specifically designed for application to the particular construction. Install system in accordance with the roofing manufacturer's instructions.

3.16 OPERATION OF EQUIPMENT DURING CONSTRUCITON

A. Clean all systems and equipment prior to initial operation for testing and balancing.

B. Do not operate equipment unless all proper safety devices or controls are operational.

C. Provide all maintenance and service for equipment which is operated during construction.

D. Do not use plumbing systems for temporary services during construction unless authorized in writing by the Architect.

3.17 SPARE PARTS

A. Provide spare for systems provided under this project including but not limited to:

B. One (1) service key for each five (5) plumbing fixtures requiring same.

C. Two (2) spare fuses for control systems.

D. Clean all systems and equipment prior to initial operation for testing and balancing.

E. Do not operate equipment unless all proper safety devices or controls are operational.

3.18 DEMONSTRATION AND INSTRUCTIONS

A. Demonstrate operation and maintenance of equipment and systems to Owner's personnel a minimum two (2) weeks prior to date of final inspection. Correct any difficulties prior to requesting final inspection.

B. For equipment requiring seasonal operation, perform instructions for other seasons at the same time.

C. Training period shall be performed within one (1) week period.

D. Contractor shall pre-test all equipment prior to requesting demonstration and instruction.

E. Use operation and maintenance manuals and videos as basis of instruction. Review contents of manual and video with personnel in detail to explain all aspects of operation and maintenance. Provide sign-in sheet for each training conducted.

F. Demonstrate the following:

1. Start up.
2. Operation.
3. Control.
4. Adjustment.
5. Trouble shooting.
6. Servicing.
7. Maintenance.
8. Shutdown.

G. Provide at least sixteen (16) hours straight time instruction to the operating personnel.

H. This instruction period shall consist of not less than two (2), eight (8) hour days.

I. Time of instruction shall be designated by the Owner.

3.19 LUBRICATION

A. All bearings, motors and all equipment requiring lubrication shall be provided with accessible fittings.

B. Before turning over the equipment to the Owner, the Installer shall provide the following:

C. Fully lubricate each item of equipment.

D. Provide one (1) year's supply of lubricant for each type of lubricant.

E. Provide complete written lubricating instructions, together with diagram locating the points requiring lubrication.

F. Motors and equipment shall be provided with grease lubricated roller or ball bearings with Alemite or equal extended grease fittings and drain plugs.

3.20 WALL AND FLOOR PENETRATION

A. All penetrations of partitions, walls and floors by piping under Division 22 shall be sealed and caulked. Provide U.L. listed fire stopping systems at penetrations through fire walls as specified in the architectural specifications.

3.21 EQUIPMENT PROVIDED UNDER ANOTHER DIVISION AND BY OTHERS

A. The Installer of products under Division 22 shall make all system connections required to equipment furnished and installed under another division and by others.

B. It shall be the responsibility of the Installer to obtain all necessary data from the equipment supplied under other Divisions.

3.22 AS BUILT DRAWINGS

A. Upon completion of the plumbing installations, the Installer shall deliver to the Architect two (2) complete sets of marked-up blueprints and electronic PDF of as-built conditions.

B. All mark-ups shall be made on the Contract Document set of drawings.

C. The mark-ups shall be legibly marked in red pencil to show all changes and departures of the installation as compared with the original design.

D. As an alternative to marking up Contract Drawings, the contractor shall provide a separate set of as-built condition plumbing drawings. This drawing set shall be complete and indicate all work provided organized by individual systems. Each system shall be represented by a unique color coding.

E. Refer to General Requirements of Division 1 for additional requirements pertaining to Submittals and Record Drawings

F. Prepare record documents in accordance with the requirements in Division 1 Section "Project Closeout." In addition to the requirements specified in Division 1, indicate the following installed conditions:

G. Mains and branches of piping systems, with valves and control devices located and numbered, concealed unions located, and with items requiring maintenance located (i.e., traps, strainers, expansion compensators, tanks, etc.). Valve location diagrams, complete with valve tag chart. Indicate actual inverts and horizontal locations of underground piping.

H. Equipment locations (exposed and concealed), dimensioned from prominent building lines.

I. Maintenance clearances and access points.

J. Numbering coordinated with contract documents and O&M manuals.

K. Approved substitutions, Contract Modifications, Responses to Contractor’s Request for Information, and actual equipment and materials installed.

L. Engage the services of a Land Surveyor or Professional Engineer registered in the state in which the project is located to record the locations and invert elevations of underground installations.

3.23 CLOSEOUT PROCEDURES

A. Operating and Maintenance Instructions: Submit Complete Package At Least Two (2) Months Prior To Substantial Completion. Arrange for each installer of equipment that requires regular maintenance to meet with the Owner's personnel to provide instruction in proper operation and maintenance. If installers are not experienced in procedures, provide instruction by manufacturer's representatives. Include a detailed review of the following items:

1. Maintenance manuals, including a customized list of preventive maintenance items and annual schedule for maintenance.
2. Record documents.
3. Complete inventory of spare parts and materials.
4. Tools.
5. Lubricants.
6. Fuels.
7. Identification systems.
8. Control sequences.
9. Hazards.
10. Cleaning.
11. Warranties and bonds.
12. Maintenance agreements and similar continuing commitments.

B. As part of instruction for operating equipment, demonstrate the following procedures:

1. Start up.
2. Shut down.
3. Emergency operations.
4. Noise and vibration adjustments.
5. Safety procedures.
6. Economy and efficiency adjustments.
7. Effective energy utilization.
8. Provide all commissioning reports.

C. Submit all documentation and obtain approval as required for LEED certification.

D. Pressure Vessel Inspections by the State of Maryland: For the purpose of obtaining and having buildings insured by any commercial insurance carrier, the Contractor shall arrange for the inspection of all pressure vessels installed during construction. The Contractor shall contact the Office of Boiler and Pressure Vessel Inspections of the Department of Labor, Licensing and Regulations (DLLR), State of Maryland, and arrange for the inspections. The DLLR shall be notified at least thirty (30) days prior to installation. After such inspections are carried out by the State Inspector’s office, Certificates of Compliance shall be issued to the Contractor of record to be turned over to the Owner’s representative for compliance with current insurance regulations as part of the Project Documents. Examples of pressure vessels include boilers, heat exchangers, converters, expansion tanks, water heaters, hot water generators and storage tanks.

3.24 FINAL CLEANING

A. General: General cleaning during construction is required by the General Conditions and included in Section “Temporary Facilities.”

B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to the condition expected in a normal, commercial building cleaning and maintenance program. Comply with manufacturer's instructions.

C. Remove all mechanical clipping, wiring, nuts, bolts, etc. left on top of ceilings and ceiling tiles.

D. Provide complete flushing of plumbing systems and strainer cleaning of all hydronic systems.

3.25 PROJECT PUNCH OUT

A. The contract shall provide the Architect/Engineer with a detailed listing of items that is remaining to complete the work indicated by the contract documents.

B. Architect/Engineer shall perform observations of the work and shall provide the Contractor with a list of punch list of items to be completed before contract closes out. Each and every punch list item shall be initialed and dated by the Contractor when the work is complete. The Architect/ Engineer shall not perform any punch list verification until all items have been completed, initialed, dated and the list returned to the Architect/Engineer. If any items have been initialed as being completed by the Contractor and the Architect/Engineer (A/E) determines that the work is not complete, the Architect/Engineer shall be reimbursed by the Contractor at the A/E regular hourly rate for any and all items requiring revisiting of the site by the Architect/Engineer. Reimbursement shall be made by deducting the Architect/Engineer fee from the Contractor's final payment.

END OF SECTION

SECTION 22 05 13 - COMMON MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on alternating-current power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

1.3 COORDINATION

A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:

1. Motor controllers.
2. Torque, speed, and horsepower requirements of the load.
3. Ratings and characteristics of supply circuit and required control sequence.
4. Ambient and environmental conditions of installation location.

PART 2 - PRODUCTS

2.1 GENERAL MOTOR REQUIREMENTS

A. Comply with NEMA MG 1 unless otherwise indicated.

B. Comply with IEEE 841 for severe-duty motors.

2.2 MOTOR CHARACTERISTICS

A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet above sea level.

B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

2.3 POLYPHASE MOTORS

A. Description: NEMA MG 1, Design B, medium induction motor.

B. Efficiency: Premium efficient, as defined in NEMA MG 1.

C. Service Factor: 1.15.

D. Multispeed Motors: Variable torque.

1. For motors with 2:1 speed ratio, consequent pole, single winding.
2. For motors with other than 2:1 speed ratio, separate winding for each speed.

E. Multispeed Motors: Separate winding for each speed.

F. Rotor: Random-wound, squirrel cage.

G. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.

H. Temperature Rise: Match insulation rating.

I. Insulation: Class F.

J. Code Letter Designation:

1. Motors 15 HP and Larger: NEMA starting Code F or Code G.
2. Motors Smaller Than 15 HP: Manufacturer's standard starting characteristic.

K. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.

2.4 ADDITIONAL REQUIREMENTS FOR POLYPHASE MOTORS

A. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.

B. Motors Used with Variable-Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.

1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width-modulated inverters.
2. Energy and Premium-Efficient Motors: Class B temperature rise; Class F insulation.
3. Inverter-Duty Motors: Class F temperature rise; Class H insulation.
4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.
5. Motor shaft Grounding Rings: Conductive microfiber shaft grounding rings to redirect shaft current to protect motor bearings.

C. Sever-Duty Motor: Comply with IEEE 841, with 1.15 minimum service factor.

2.5 SINGLE-PHASE MOTORS

A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:

1. Permanent-split capacitor.
2. Split phase.
3. Capacitor start, inductor run.
4. Capacitor start, capacitor run.
5. Electronically commutated motor, ECM.

B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.

C. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.

D. Motors 1/20 HP and Smaller: Shaded-pole type.

E. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

PART 3 - EXECUTION (Not Applicable)

END OF SECTION

THIS PAGE IS INTENTIONALLY LEFT BLANK.

SECTION 22 05 16 - EXPANSION FITTINGS AND LOOPS FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Alignment guides and anchors.
2. Pipe loops and swing connections.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Delegated-Design Submittal: For each anchor and alignment guide, including analysis data, signed and sealed by the qualified professional engineer responsible for their preparation.

1. Design Calculations: Calculate requirements for thermal expansion of piping systems and for selecting and designing expansion joints, loops, and swing connections.
2. Anchor Details: Detail fabrication of each anchor indicated. Show dimensions and methods of assembly and attachment to building structure.
3. Alignment Guide Details: Detail field assembly and attachment to building structure.
4. Schedule: Indicate type, manufacturer's number, size, material, pressure rating, end connections, and location for each expansion joint.

1.4 INFORMATIONAL SUBMITTALS

A. Welding certificates.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For expansion joints to include in maintenance manuals.

1.6 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Pipe and Pressure-Vessel Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Compatibility: Products shall be suitable for piping service fluids, materials, working pressures, and temperatures.

B. Capability: Products to absorb 200 percent of maximum axial movement between anchors.

2.2 ALIGNMENT GUIDES AND ANCHORS

A. Alignment Guides:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Flex-Hose Co., Inc.
   b. Flexicraft Industries.
   c. Mason Industries, Inc.
   d. Metraflex Company (The).

2. Source Limitations: Obtain alignment guides from single manufacturer.
3. Description: Steel, factory-fabricated alignment guide, with bolted two-section outer cylinder and base for attaching to structure; with two-section guiding slider for bolting to pipe.

B. Anchor Materials:

1. Steel Shapes and Plates: ASTM A36/A36M.
2. Bolts and Nuts: ASME B18.10 or ASTM A183, steel hex head.
3. Washers: ASTM F844, steel, plain, flat washers.
4. Mechanical Fasteners: Insert-wedge-type stud with expansion plug anchor for use in hardened portland cement concrete, with tension and shear capacities appropriate for application.Stainless-steel studs are available.

   a. Stud: Threaded, zinc-coated carbon steel.
   b. Expansion Plug: Zinc-coated steel.
   c. Washer and Nut: Zinc-coated steel.

5. Chemical Fasteners: Insert-type stud, bonding-system anchor for use with hardened portland cement concrete, with tension and shear capacities appropriate for application.

   a. Bonding Material: ASTM C881/C881M, Type IV, Grade 3, two-component epoxy resin suitable for surface temperature of hardened concrete where fastener is to be installed.
   b. Stud: ASTM A307, zinc-coated carbon steel with continuous thread on stud, unless otherwise indicated.
   c. Washer and Nut: Zinc-coated steel.

PART 3 - EXECUTION

3.1 PIPE LOOP AND SWING CONNECTION INSTALLATION

A. Install pipe loops cold-sprung in tension or compression as required to partly absorb tension or compression produced during anticipated change in temperature.

B. Connect risers and branch connections to mains with at least five pipe fittings, including tee in main.

C. Connect risers and branch connections to terminal units with at least four pipe fittings, including tee in riser.

D. Connect mains and branch connections to terminal units with at least four pipe fittings, including tee in main.

3.2 ALIGNMENT-GUIDE AND ANCHOR INSTALLATION

A. Install alignment guides to guide expansion and to avoid end-loading and torsional stress.

B. Install one guide(s) on each side of pipe expansion fittings and loops. Install guides nearest to expansion joint not more than four pipe diameters from expansion joint.

C. Attach guides to pipe, and secure guides to building structure.

D. Install anchors at locations to prevent stresses from exceeding those permitted by ASME B31.9 and to prevent transfer of loading and stresses to connected equipment.

E. Anchor Attachments:

1. Anchor Attachment to Steel Pipe: Attach by welding. Comply with ASME B31.9 and ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
2. Anchor Attachment to Copper Tubing: Attach with pipe hangers. Use MSS SP-69, Type 24; U bolts bolted to anchor.

F. Fabricate and install steel anchors by welding steel shapes, plates, and bars. Comply with ASME B31.9 and AWS D1.1/D1.1M.

1. Anchor Attachment to Steel Structural Members: Attach by welding.
2. Anchor Attachment to Concrete Structural Members: Attach by fasteners. Follow fastener manufacturer's written instructions.

G. Use grout to form flat bearing surfaces for guides and anchors attached to concrete.

END OF SECTION

THIS PAGE IS INTENTIONALLY LEFT BLANK.

SECTION 220517 - SLEEVES AND SLEEVE SEALS FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Sleeves without waterstop.
2. Sleeves with waterstop.
3. Stack-sleeve fittings.
4. Sleeve-seal systems.
5. Grout.
6. Silicone sealants.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.3 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

PART 2 - PRODUCTS

2.1 SLEEVES WITHOUT WATERSTOP

A. Cast-Iron Pipe Sleeves: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends.

B. Steel Pipe Sleeves: ASTM A53/A53M, Type E, Grade B, Schedule 40, hot-dip galvanized, with plain ends.

C. Steel Sheet Sleeves: ASTM A653/A653M, 0.0239-inch minimum thickness; hot-dip galvanized, round tube closed with welded longitudinal joint.

2.2 SLEEVES WITH WATERSTOP

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Advance Products & Systems, LLC.
2. CALPICO, Inc.
3. GPT; a division of EnPRO Industries.
4. Metraflex Company (The).

B. Description: Manufactured galvanized steel, sleeve-type, waterstop assembly made for imbedding in concrete slab or wall.

2.3 STACK-SLEEVE FITTINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Jay R. Smith Mfg Co; a division of Morris Group International.
2. Wade; a subsidiary of McWane Inc.
3. Zurn Industries, LLC.

B. Description: Manufactured, Dura-coated or Duco-coated cast-iron sleeve with integral clamping flange for use in waterproof floors and roofs. Include clamping ring, bolts, and nuts for membrane flashing.

1. Underdeck Clamp: Clamping ring with setscrews.

2.4 SLEEVE-SEAL SYSTEMS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Advance Products & Systems, LLC.
2. CALPICO, Inc.
3. GPT; a division of EnPRO Industries.
4. Metraflex Company (The).

B. Description: Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.

1. Designed to form a hydrostatic seal of 20 psig minimum.
2. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
3. Pressure Plates: Stainless steel.
4. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements.

2.5 GROUT

A. Description: Nonshrink, for interior and exterior sealing openings in non-fire-rated walls or floors.

B. Standard: ASTM C1107/C1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

C. Design Mix: 5000 psi, 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

2.6 SILICONE SEALANTS

A. Silicone, S, NS, 25, NT: Single-component, non-sag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant.
   1. Standard: ASTM C920, Type S, Grade NS, Class 25, Use NT.

B. Silicone, S, P, T, NT: Single-component, 100/50, pourable, plus 100 percent and minus 50 percent movement capability, traffic- and nontraffic-use, neutral-curing silicone joint sealant.

   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

      a. Pecora Corporation.
      b. Sika Corporation.
      c. The Dow Chemical Company.
      d. Tremco Incorporated.

   2. Standard: ASTM C920, Type S, Grade P, Class 100/50, Uses T and NT.

C. Silicone Foam: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

   1. Manufacturers: Subject to compliance with requirements, provide products by the following:

      a. Smooth-On.

PART 3 - EXECUTION

3.1 INSTALLATION OF SLEEVES - GENERAL

A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.

B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch annular clear space between piping and concrete slabs and walls.

   1. Sleeves are not required for core-drilled holes.

C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.

   1. Permanent sleeves are not required for holes in slabs formed by molded-PE or -PP sleeves.
   2. Cut sleeves to length for mounting flush with both surfaces.

      a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level.

   3. Using grout or silicone sealant, seal the space outside of sleeves in slabs and walls without sleeve-seal system.

D. Install sleeves for pipes passing through interior partitions.

1. Cut sleeves to length for mounting flush with both surfaces.
2. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint.

E. Fire-Resistance-Rated Penetrations, Horizontal Assembly Penetrations, and Smoke Barrier Penetrations: Maintain indicated fire or smoke rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with fire- and smoke-stop materials. Comply with requirements for firestopping and fill materials specified in Section 078413 "Penetration Firestopping."

3.2 INSTALLATION OF SLEEVES WITH WATERSTOP

A. Install sleeve with waterstop as new walls and slabs are constructed.

B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.

C. Secure nailing flanges to concrete forms.

D. Using grout or silicone sealant, seal the space around outside of sleeves.

3.3 INSTALLATION OF STACK-SLEEVE FITTINGS

A. Install stack-sleeve fittings in new slabs as slabs are constructed.

1. Install fittings that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
2. Secure flashing between clamping flanges for pipes penetrating floors with membrane waterproofing. Comply with requirements for flashing specified in Section 076200 "Sheet Metal Flashing and Trim."
3. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level.
4. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
5. Using waterproof silicone sealant, seal space between top hub of stack-sleeve fitting and pipe.

B. Fire-Resistance-Rated Penetrations, Horizontal Assembly Penetrations, and Smoke Barrier Penetrations: Maintain indicated fire or smoke rating of floors at pipe penetrations. Seal pipe penetrations with fire- and smoke-stop materials. Comply with requirements for firestopping specified in Section 078413 "Penetration Firestopping."

3.4 INSTALLATION OF SLEEVE-SEAL SYSTEMS

A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building, and passing through exterior walls.

B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal system components, and install in annular space between piping and

sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

3.5 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Leak Test: After allowing for a full cure, test sleeves and sleeve seals for leaks. Repair leaks and retest until no leaks exist.
2. Sleeves and sleeve seals will be considered defective if they do not pass tests and inspections.

B. Prepare test and inspection reports.

3.6 SLEEVE SCHEDULE

A. Use sleeves and sleeve seals for the following piping-penetration applications:

1. Exterior Concrete Walls above and below Grade:

a. Sleeves with waterstops.

1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.

2. Concrete Slabs-on-Grade:

a. Sleeves with waterstops.

1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.

3. Concrete Slabs above Grade:

a. Sleeves with waterstops or stack-sleeve fittings.

4. Interior Partitions:

a. Sleeves without waterstops.

END OF SECTION 220517

This page is intentionally left blank.

SECTION 22 05 18 - ESCUTCHEONS FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Escutcheons.
2. Floor plates.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. BrassCraft Manufacturing Co.; a Masco company.
2. Dearborn Brass.
3. Jones Stephens Corp.
4. Keeney Manufacturing Company (The).
5. Mid-America Fittings, Inc.

2.2 ESCUTCHEONS

A. One-Piece, Cast-Brass Type: With polished, chrome-plated finish and setscrew fastener.

B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished, chrome-plated finish and spring-clip fasteners.

2.3 FLOOR PLATES

A. Split Floor Plates: Cast brass with concealed hinge.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.

B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of insulated piping and with OD that completely covers opening.

1. Escutcheons for New Piping:

    a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep pattern.
    b. Chrome-Plated Piping: One-piece cast brass with polished, chrome-plated finish.
    c. Insulated Piping: One-piece cast brass with polished, chrome-plated finish.
    d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece cast brass with polished, chrome-plated finish.
    e. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece cast brass with polished, chrome-plated finish.
    f. Bare Piping in Unfinished Service Spaces: One-piece steel with polished, chrome-plated finish.
    g. Bare Piping in Unfinished Service Spaces: One-piece cast brass with polished, chrome-plated finish.
    h. Bare Piping in Equipment Rooms: One-piece cast brass with polished, chrome-plated finish.

C. Install floor plates for piping penetrations of equipment-room floors.

D. Install floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.

1. New Piping: One-piece, floor plate.

3.2 FIELD QUALITY CONTROL

A. Using new materials, replace broken and damaged escutcheons and floor plates.

END OF SECTION

SECTION 22 05 19 - METERS AND GAGES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Light-activated thermometers.
2. Thermowells.
3. Dial-type pressure gages.
4. Gage attachments.
5. Test plugs.
6. Test-plug kits.

B. Related Requirements:

1. Section 22 11 13 "Facility Water Distribution Piping" for domestic water meters and combined domestic and fire-protection water-service meters outside the building.
2. Section 22 11 19 "Domestic Water Piping Specialties" for water meters.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.4 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of meter and gage.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For meters and gages to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 LIGHT-ACTIVATED THERMOMETERS

A. Direct-Mounted, Light-Activated Thermometers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. AMETEK, Inc. U.S. Gauge.
b. Ashcroft, Inc.
c. Flo Fab Inc.
d. REOTEMP Instrument Corporation.
e. Trerice, H. O. Co.

f. Weiss Instruments, Inc.

2. Case: Metal; 7-inch nominal size unless otherwise indicated.
3. Scale(s): Deg F.
4. Case Form: Adjustable angle.
5. Connector: 1-1/4 inches, with ASME B1.1 screw threads.
6. Stem: Aluminum and of length to suit installation.

a. Design for Thermowell Installation: Bare stem.

7. Display: Digital.
8. Accuracy: Plus or minus 2 deg F.

2.2 THERMOWELLS

A. Thermowells:

1. Standard: ASME B40.200.
2. Description: Pressure-tight, socket-type fitting made for insertion into piping tee fitting.
3. Material for Use with Copper Tubing: CNR or CUNI.
4. Material for Use with Steel Piping: CRES.
5. Type: Stepped shank unless straight or tapered shank is indicated.
6. External Threads: NPS 1/2, NPS 3/4, or NPS 1, ASME B1.20.1 pipe threads.
7. Internal Threads: 1/2, 3/4, and 1 inch, with ASME B1.1 screw threads.
8. Bore: Diameter required to match thermometer bulb or stem.
9. Insertion Length: Length required to match thermometer bulb or stem.
10. Lagging Extension: Include on thermowells for insulated piping and tubing.
11. Bushings: For converting size of thermowell's internal screw thread to size of thermometer connection.

B. Heat-Transfer Medium: Mixture of graphite and glycerin.

2.3 PRESSURE GAGES

A. Direct-Mounted, Metal-Case, Dial-Type Pressure Gages:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Ametek U.S. Gauge.
b. Ashcroft Inc.
c. Flo Fab Inc.
d. Trerice, H. O. Co.
e. WATTS.
f. Weiss Instruments, Inc.

2. Standard: ASME B40.100.
3. Case: Liquid-filled, Solid-front, pressure relief type(s); cast aluminum or drawn steel; 4-1/2-inch nominal diameter.
4. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
5. Pressure Connection: Brass, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
6. Movement: Mechanical, with link to pressure element and connection to pointer.
7. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi.
8. Pointer: Dark-colored metal.

9. Window: Glass.
10. Ring: Stainless steel.
11. Accuracy: Grade C, plus or minus 3 percent of middle half of scale range.

2.4 GAGE ATTACHMENTS

A. Snubbers: ASME B40.100, brass; with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and piston-type surge-dampening device. Include extension for use on insulated piping.

B. Valves: Brass or stainless-steel needle, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads.

2.5 TEST PLUGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Flow Design, Inc.
2. Miljoco Corporation.
3. Nexus Valve, Inc.
4. Peterson Equipment Co., Inc.
5. Sisco Manufacturing Company, Inc.
6. Trerice, H. O. Co.
7. WATTS.
8. Weiss Instruments, Inc.

B. Description: Test-station fitting made for insertion into piping tee fitting.

C. Body: Brass or stainless steel with core inserts and gasketed and threaded cap. Include extended stem on units to be installed in insulated piping.

D. Thread Size: NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe thread.

E. Minimum Pressure and Temperature Rating: 500 psig at 200 deg F.

F. Core Inserts: EPDM self-sealing rubber.

2.6 TEST-PLUG KITS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Flow Design, Inc.
2. Miljoco Corporation.
3. Nexus Valve, Inc.
4. Peterson Equipment Co., Inc.
5. Sisco Manufacturing Company, Inc.
6. Trerice, H. O. Co.
7. WATTS.

B. Furnish one test-plug kit(s) containing two thermometer(s), one pressure gage and adapter, and carrying case. Thermometer sensing elements, pressure gage, and adapter probes shall be of diameter to fit test plugs and of length to project into piping.

C. Low-Range Thermometer: Small, bimetallic insertion type with 1- to 2-inch- diameter dial and tapered-end sensing element. Dial range shall be at least 25 to 125 deg F.

D. High-Range Thermometer: Small, bimetallic insertion type with 1- to 2-inch- diameter dial and tapered-end sensing element. Dial range shall be at least 0 to 220 deg F.

E. Pressure Gage: Small, Bourdon-tube insertion type with 2- to 3-inch- diameter dial and probe. Dial range shall be at least 0 to 200 psig.

F. Carrying Case: Metal or plastic, with formed instrument padding.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install thermowells with socket extending to center of pipe and in vertical position in piping tees.

B. Install thermowells of sizes required to match thermometer connectors. Include bushings if required to match sizes.

C. Install thermowells with extension on insulated piping.

D. Fill thermowells with heat-transfer medium.

E. Install direct-mounted thermometers in thermowells and adjust vertical and tilted positions.

F. Install direct-mounted pressure gages in piping tees with pressure gage located on pipe at the most readable position.

G. Install valve and snubber in piping for each pressure gage for fluids.

H. Install test plugs in piping tees.

I. Install thermometers in the following locations:

1. Inlet and outlet of each water heater.

J. Install pressure gages in the following locations:
1. Building water service entrance into building.
2. Inlet and outlet of each pressure-reducing valve.
3. Suction and discharge of each domestic water pump.

3.2 CONNECTIONS

A. Install meters and gages adjacent to machines and equipment to allow service and maintenance of meters, gages, machines, and equipment.

3.3 ADJUSTING

A. Adjust faces of meters and gages to proper angle for best visibility.

3.4 THERMOMETER SCHEDULE

A. Thermometers at inlet and outlet of each domestic water heater shall be the following:

1. Direct-mounted, light-activated type.
2. Test plug with EPDM self-sealing rubber inserts.

B. Thermometer stems shall be of length to match thermowell insertion length.

3.5 THERMOMETER SCALE-RANGE SCHEDULE

A. Scale Range for Domestic Cold-Water Piping: 0 to 100 deg F.

B. Scale Range for Domestic Hot-Water Piping: 0 to 250 deg F.

3.6 PRESSURE-GAGE SCHEDULE

A. Pressure gages at discharge of each water service into building shall be the following:

1. Liquid-filled, Solid-front, pressure-relief, direct-mounted, metal case.
2. Test plug with EPDM self-sealing rubber inserts.

B. Pressure gages at inlet and outlet of each water pressure-reducing valve shall be the following:

1. Liquid-filled, Solid-front, pressure-relief], direct-mounted, metal case.
2. Test plug with EPDM self-sealing rubber inserts.

C. Pressure gages at suction and discharge of each domestic water pump shall be one of the following:

1. Liquid-filled, Solid-front, pressure-relief, direct-mounted, metal case.
2. Test plug with EPDM self-sealing rubber inserts.

3.7 PRESSURE-GAGE SCALE-RANGE SCHEDULE

A. Scale Range for Water Service Piping: 0 to 160 psi.

B. Scale Range for Domestic Water Piping: 0 to 160 psi.

END OF SECTION

THIS PAGE IS INTENTIONALLY LEFT BLANK.

SECTION 22 05 23.12 - BALL VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Bronze ball valves.

1.3 DEFINITIONS

A. CWP: Cold working pressure.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of valve.

1. Certification that products comply with NSF 61 and NSF 372.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:

1. Protect internal parts against rust and corrosion.
2. Protect threads, flange faces, and soldered ends.
3. Set ball valves open to minimize exposure of functional surfaces.

B. Use the following precautions during storage:

1. Maintain valve end protection.
2. Store valves indoors and maintain at higher-than-ambient-dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use operating handles or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.

B. ASME Compliance:

1. ASME B1.20.1 for threads for threaded end valves.

2. ASME B16.18 for solder-joint connections.
3. ASME B31.9 for building services piping valves.

C. NSF Compliance: NSF 61 and NSF 372 for valve materials for potable-water service.

D. Bronze valves shall be made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are not permitted.

E. Valve Pressure-Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

F. Valve Sizes: Same as upstream piping unless otherwise indicated.

G. Valve Actuator Types:

1. Gear Actuator: For quarter-turn valves NPS 4 and larger.
2. Handlever: For quarter-turn valves smaller than NPS 4.

H. Valves in Insulated Piping:

1. Include 2-inch stem extensions.
2. Extended operating handles of nonthermal-conductive material and protective sleeves that allow operation of valves without breaking vapor seals or disturbing insulation.
3. Memory stops that are fully adjustable after insulation is applied.

2.2 BRONZE BALL VALVES

A. Bronze Ball Valves, Two-Piece with Full Port, and Bronze or Brass Trim, Soldered Ends:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Apollo Flow Controls; Conbraco Industries, Inc.
b. Crane; Crane Energy Flow Solutions.
c. Hammond Valve.
d. Milwaukee Valve Company.
e. WATTS.

2. Description:

a. Standard: MSS SP-110 or MSS-145.
b. CWP Rating: 600 psig.
c. Body Design: Two piece.
d. Body Material: Bronze.
e. Ends: Soldered.
f. Seats: PTFE.
g. Stem: Bronze or brass.
h. Ball: Chrome-plated brass.
i. Port: Full.
j. Pipe Extensions: Required.

B. Bronze Ball Valves, Two-Piece with Full Port, and Bronze or Brass Trim, Press Ends:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Apollo Flow Controls; Conbraco Industries, Inc.
b. Crane; Crane Energy Flow Solutions.
c. Hammond Valve.
d. Milwaukee Valve Company.
e. WATTS.

2. Description:

a. Standard: MSS SP-110 or MSS-145.
b. CWP Rating: Minimum 200 psig.
c. Body Design: Two piece.
d. Body Material: Bronze.
e. Ends: Press.
f. Press Ends Connections Rating: Minimum 200 psig.
g. Seats: PTFE or RTPFE.
h. Stem: Bronze or brass.
i. Ball: Chrome-plated brass.
j. Port: Full.
k. O-Ring Seal: EPDM or Buna-N.

C. Bronze Ball Valves, Two-Piece, Safety-Exhaust:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Apollo Flow Controls; Conbraco Industries, Inc.
b. Jamesbury; Metso.

2. Description:

a. Standard: MSS SP-110.
b. CWP Rating: 600 psig.
c. Body Design: Two piece.
d. Body Material: Bronze, ASTM B584, Alloy C844.
e. Ends: Threaded.
f. Seats: PTFE.
g. Stem: Stainless steel.
h. Ball: Chrome-plated brass, with exhaust vent opening for pneumatic applications.
i. Port: Full.
j. Lead Free: Required.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

C. Examine threads on valve and mating pipe for form and cleanliness.

D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

E. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE INSTALLATION

A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

B. Locate valves for easy access and provide separate support where necessary.

C. Install valves in horizontal piping with stem at or above center of pipe.

D. Install valves in position to allow full stem movement.

E. Install valve tags. Comply with requirements in Section 22 05 53 "Identification for Plumbing Piping and Equipment" for valve tags and schedules.

3.3 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

A. If valves with specified CWP ratings are unavailable, the same types of valves with higher CWP ratings may be substituted.

B. Select valves with the following end connections:

1. For Copper Tubing, NPS 4 and Smaller: Threaded ends except where solder-joint valve-end option or press-end option is indicated in valve schedules below.

3.4 DOMESTIC HOT- AND COLD-WATER VALVE SCHEDULE

A. Pipe NPS 4 and Smaller:

1. Bronze ball valves, two-piece with full port and bronze or brass trim. Provide with solder or press connection-joint ends.

END OF SECTION

SECTION 22 05 23.13 - BUTTERFLY VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Iron, single-flange (lug-type) butterfly valves.
2. Chainwheels.

1.2 DEFINITIONS

A. CWP: Cold working pressure.

B. EPDM: Ethylene propylene-diene terpolymer rubber.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of valve.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:

1. Protect internal parts against rust and corrosion.
2. Protect threads, flange faces, grooves, and weld ends.
3. Set butterfly valves closed or slightly open.

B. Use the following precautions during storage:

1. Maintain valve end protection.
2. Store valves indoors and maintain at higher-than-ambient-dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Obtain each type of valve from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Standards:

1. Domestic water piping specialties intended to convey or dispense water for human consumption must comply with the SDWA, requirements of authorities having jurisdiction, and NSF 61 and NSF 372, or must be certified to be in compliance with NSF 61 and NSF 372 (by an ANSI-accredited third-party certification body) that the weighted average lead content at wetted surfaces is less than or equal to 0.25 percent.

B. ASME Compliance:

1. ASME B16.1 for flanges on iron valves.
2. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
3. ASME B31.9 for building services valves.

C. AWWA Compliance: Comply with AWWA C606 for grooved-end connections.

D. Valve Pressure-Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

E. Valve Sizes: Same as upstream piping unless otherwise indicated.

F. Valve Actuator Types:

1. Gear Actuator: For valves NPS 8 and larger.
2. Hand lever: For valves NPS 6 and smaller.
3. Chainwheel: Device for attachment to gear, handlever, or stem; of size and with chain for mounting height, according to "Installation of Valves" Article.

G. Valves in Insulated Piping: Provide 2-inch extended neck stems.

2.3 IRON, SINGLE-FLANGE (LUG-TYPE) BUTTERFLY VALVES

A. Iron, Single-Flange (Lug-Type) Butterfly Valves with Aluminum-Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Apollo Valves; a part of Aalberts Integrated Piping Systems.
b. Bray Commercial.
c. Center Line; a Crane Co. brand.
d. DeZURIK.
e. Hammond Valve.
f. Jenkins Valves; a Crane Co. brand.

2. Standard: MSS SP-67, Type I.
3. CWP Rating: 200 psig.
4. Body Design: Single flange (lug type), suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
5. Body Material: ASTM A126, cast iron or ASTM A536, ductile iron.
6. Seat: EPDM.
7. Stem: One- or two-piece stainless steel.
8. Disc: Aluminum bronze.

2.4 CHAINWHEELS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Babbitt Steam Specialty Co.
2. Roto Hammer Industries; Rotork.
3. Trumbull Industries.

B. Description: Valve actuation assembly with sprocket rim, chain guides, chain, and attachment brackets for mounting chainwheels directly to handwheels.

1. Sprocket Rim with Chain Guides: Ductile or cast iron, of type and size required for valve. Include zinc or epoxy coating.
2. Chain: Brass, of size required to fit sprocket rim.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

C. Examine mating flange faces for damage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

D. Do not attempt to repair defective valves; replace with new valves. Remove defective valves from site.

3.2 INSTALLATION OF VALVES

A. Install valves with unions or flanges at each piece of equipment arranged to allow space for service, maintenance, and equipment removal without system shutdown.

B. Provide support to piping adjacent to valves such that no force is imposed upon valves.

C. Locate valves for easy access.

D. Install valves in horizontal piping with stem at or above center of pipe.

E. Install valves in position to allow full valve actuation movement.

F. Install chainwheels on actuators for butterfly valves NPS 4 and larger and more than 96 inches above floor. Extend chains to 60 inches above finished floor.

G. Valve Tags: Comply with requirements in Section 220553 "Identification for Plumbing Piping and Equipment" for valve tags and schedules.

3.3 ADJUSTING

A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. If leakage cannot be repaired, replace valves.

3.4 DOMESTIC HOT- AND COLD-WATER VALVE SCHEDULE

A. Pipe NPS 2-1/2 and Larger:

1. Iron, Single-Flange (Lug-Type) Butterfly Valves: 200 CWP, EPDM seat, and aluminum-bronze disc.

END OF SECTION

SECTION 22 05 23.14 - CHECK VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Bronze lift check valves.
2. Bronze swing check valves.
3. Bronze swing check valves, press ends.

1.3 DEFINITIONS

A. CWP: Cold working pressure.

B. EPDM: Ethylene propylene-diene terpolymer rubber.

C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of valve.

1. Certification that products comply with NSF 61 and NSF 372.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:

1. Protect internal parts against rust and corrosion.
2. Protect threads, flange faces, grooves, and weld ends.
3. Set check valves in either closed or open position.

B. Use the following precautions during storage:

1. Maintain valve end protection.
2. Store valves indoors and maintain at higher-than-ambient-dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.

B. ASME Compliance:

1. ASME B1.20.1 for threads for threaded end valves.
2. ASME B16.18 for solder joint.
3. ASME B31.9 for building services piping valves.

C. Drinking Water System Components - Health Effects and Drinking Water System Components - Lead Content Compliance: NSF 61 and NSF 372.

D. Bronze valves shall be made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are not permitted.

E. Valve Pressure-Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

F. Valve Sizes: Same as upstream piping unless otherwise indicated.

G. Valve Bypass and Drain Connections: MSS SP-45.

2.2 BRONZE LIFT CHECK VALVES

A. Bronze Lift Check Valves with Bronze Disc, Class 125:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Crane; Crane Energy Flow Solutions.
b. Jenkins Valves; Crane Energy Flow Solutions.
c. Stockham Valves.

2. Description:

a. Standard: MSS SP-80, Type 1.
b. CWP Rating: 200 psig.
c. Body Design: Vertical flow.
d. Body Material: ASTM B61 or ASTM B62, bronze.
e. Ends: Threaded or soldered. See valve schedule articles.
f. Disc: Bronze.

2.3 BRONZE SWING CHECK VALVES

A. Bronze Swing Check Valves with Bronze Disc, Class 125:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Apollo Flow Controls; Conbraco Industries, Inc.
b. Crane; Crane Energy Flow Solutions.

c. Hammond Valve.
d. Jenkins Valves; Crane Energy Flow Solutions.
e. Milwaukee Valve Company.

2. Description:

a. Standard: MSS SP-80, Type 3.
b. CWP Rating: 200 psig.
c. Body Design: Horizontal flow.
d. Body Material: ASTM B62, bronze.
e. Ends: Threaded or soldered. See valve schedule articles.
f. Disc: Bronze.

B. Bronze Swing Check Valves, Press Ends:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Apollo Flow Controls; Conbraco Industries, Inc.
b. Elkhart Products Corporation.
c. Milwaukee Valve Company.

2. Description:

a. Standard: MSS SP-80 and MSS SP-139.
b. CWP Rating: Minimum 200 psig.
c. Body Design: Horizontal flow.
d. Body Material: ASTM B584, bronze.
e. Ends: Press.
f. Press Ends Connection Rating: Minimum 200 psig
g. Disc: Brass or bronze.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

C. Examine threads on valve and mating pipe for form and cleanliness.

D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

E. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE INSTALLATION

A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

B. Locate valves for easy access and provide separate support where necessary.

C. Install valves in horizontal piping with stem at or above center of pipe.

D. Install valves in position to allow full stem movement.

E. Check Valves: Install check valves for proper direction of flow.

1. Swing Check Valves: In horizontal position with hinge pin level.
2. Lift Check Valves: With stem upright and plumb.

F. Install valve tags. Comply with requirements in Section 22 05 53 "Identification for Plumbing Piping and Equipment" for valve tags and schedules.

3.3 ADJUSTING

A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

A. If valve applications are not indicated, use the following:

1. Pump-Discharge Check Valves:

a. NPS 4 and Smaller: Bronze swing check valves with bronze disc.

B. If valves with specified CWP ratings are unavailable, the same types of valves with higher CWP ratings may be substituted.

C. End Connections:

1. For Copper Tubing, NPS 4 and Smaller: soldered or press-ends.

3.5 DOMESTIC HOT- AND COLD-WATER VALVE SCHEDULE

A. Pipe NPS 4 and Smaller:

1. Bronze swing check valves with bronze disc, Class 125, with soldered end connections.
2. Bronze swing check valves with press-end connections.

END OF SECTION

SECTION 22 05 23.15 - GATE VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Iron gate valves.

1.3 DEFINITIONS

A. CWP: Cold working pressure.

B. NRS: Nonrising stem.

C. OS&Y: Outside screw and yoke.

D. RS: Rising stem.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of valve.
   1. Certification that products comply with NSF 61 and NSF 372.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:
   1. Protect internal parts against rust and corrosion.
   2. Protect threads, flange faces, grooves, and weld ends.
   3. Set gate valves closed to prevent rattling.

B. Use the following precautions during storage:
   1. Maintain valve end protection.
   2. Store valves indoors and maintain at higher-than-ambient-dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.

B. ASME Compliance:
   1. ASME B1.20.1 for threads for threaded end valves.
   2. ASME B16.1 for flanges on iron valves.

3. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
4. ASME B31.9 for building services piping valves.

C. NSF Compliance: NSF 61 and NSP 372 for valve materials for potable-water service.

D. Bronze valves shall be made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are not permitted.

E. Valve Pressure-Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

F. Valve Sizes: Same as upstream piping unless otherwise indicated.

G. RS Valves in Insulated Piping: With 2-inch stem extensions.

H. Valve Bypass and Drain Connections: MSS SP-45.

2.2 IRON GATE

A. Iron Gate Valves, OS&Y, Class 125:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Apollo Flow Controls; Conbraco Industries, Inc.
   b. Crane; Crane Energy Flow Solutions.
   c. Hammond Valve.
   d. Jenkins Valves; Crane Energy Flow Solutions.
   e. Milwaukee Valve Company.
   f. Powell Valves.
   g. Stockham; Crane Energy Flow Solutions.
   h. WATTS.
2. Description:
   a. Standard: MSS SP-70, Type I.
   b. CWP Rating: 200 psig.
   c. Body Material: Gray iron with bolted bonnet.
   d. Ends: Flanged.
   e. Trim: Bronze.
   f. Disc: Solid wedge.
   g. Packing and Gasket: Asbestos free.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

C. Examine threads on valve and mating pipe for form and cleanliness.

D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

E. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE INSTALLATION

A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

B. Locate valves for easy access and provide separate support where necessary.

C. Install valves in horizontal piping with stem at or above center of pipe.

D. Install valves in position to allow full stem movement.

E. Install valve tags. Comply with requirements in Section 22 05 53 "Identification for Plumbing Piping and Equipment" for valve tags and schedules.

3.3 ADJUSTING

A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

A. Use gate valves for shutoff service only at service entrance backflow preventer.

B. If valves with specified CWP ratings are unavailable, the same types of valves with higher CWP ratings may be substituted.

3.5 DOMESTIC HOT- AND COLD-WATER VALVE SCHEDULE

A. Pipe NPS 2-1/2 and Larger: Iron gate valves, NRS, Class 150 with flanged ends.

END OF SECTION

THIS PAGE IS INTENTIONALLY LEFT BLANK.

SECTION 22 05 29 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Metal pipe hangers and supports.
2. Trapeze pipe hangers.
3. Metal framing systems.
4. Thermal hanger-shield inserts.
5. Fastener systems.
6. Pipe-positioning systems.
7. Equipment supports.

B. Related Requirements:

1. Section 05 50 00 "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
2. Section 22 05 16 "Expansion Fittings and Loops for Plumbing Piping" for pipe guides and anchors.
3. Section 22 05 48.13 "Vibration Controls for Plumbing Piping and Equipment" for vibration isolation devices.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Environmental Product Declaration: For each product.
2. Health Product Declaration: For each product.
3. Sourcing of Raw Materials: Corporate sustainability report for each manufacturer.

B. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following:

1. Trapeze pipe hangers.
2. Metal framing systems.
3. Equipment supports.

C. Delegated-Design Submittal: For trapeze hangers indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Detail fabrication and assembly of trapeze hangers.
2. Include design calculations for designing trapeze hangers.

1.4 INFORMATIONAL SUBMITTALS

A. Welding certificates.

1.5 QUALITY ASSURANCE

A. Structural-Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M.

B. Pipe Welding Qualifications: Qualify procedures and operators according to 2015 ASME Boiler and Pressure Vessel Code, Section IX.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design trapeze pipe hangers and equipment supports.

2.2 METAL PIPE HANGERS AND SUPPORTS

A. Carbon-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Galvanized Metallic Coatings: Pregalvanized, hot-dip galvanized, or electro-galvanized.
3. Nonmetallic Coatings: Plastic coated or epoxy powder coated.
4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
5. Hanger Rods: Continuous-thread rod, nuts, and washer made of [carbon steel] [stainless steel] <Insert material>.

B. Stainless-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
3. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.

C. Copper Pipe and Tube Hangers:

1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.
2. Hanger Rods: Continuous-thread rod, nuts, and washer made of copper-coated steel.

2.3 TRAPEZE PIPE HANGERS

A. Description: MSS SP-58, Type 59, shop- or field-fabricated pipe-support assembly, made from structural-carbon-steel shapes, with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

2.4 METAL FRAMING SYSTEMS

A. MFMA Manufacturer Metal Framing Systems:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. B-line, an Eaton business.
    b. Flex-Strut Inc.
    c. G-Strut.
    d. Haydon Corporation.
    e. Thomas & Betts Corporation; A Member of the ABB Group.
    f. Unistrut; Part of Atkore International.

2. Description: Shop- or field-fabricated pipe-support assembly, made of steel channels, accessories, fittings, and other components for supporting multiple parallel pipes.
3. Standard: Comply with MFMA-4, factory-fabricated components for field assembly.
4. Channels: Continuous slotted carbon-steel channel with inturned lips.
5. Channel Width: Selected for applicable load criteria.
6. Channel Nuts: Formed or stamped nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
7. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.
8. Paint Coating: Green epoxy, acrylic, or urethane.

B. Non-MFMA Manufacturer Metal Framing Systems:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. Anvil International.
    b. Carpenter & Paterson, Inc.
    c. Empire Industries, Inc.
    d. FNW; Ferguson Enterprises, Inc.
    e. Gripple Inc.
    f. MIRO Industries.

2. Description: Shop- or field-fabricated pipe-support assembly, made of steel channels, accessories, fittings, and other components for supporting multiple parallel pipes.
3. Standard: Comply with MFMA-4, factory-fabricated components for field assembly.
4. Channels: Continuous slotted carbon-steel channel with inturned lips.
5. Channel Width: Select for applicable load criteria.
6. Channel Nuts: Formed or stamped nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
7. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.
8. Paint Coating: Green epoxy, acrylic, or urethane.

2.5 THERMAL HANGER-SHIELD INSERTS

A. Manufacturers: Subject to compliance with requirements, [provide products by one of the following:

1. Buckaroos, Inc.
2. Carpenter & Paterson, Inc.
3. Clement Support Services.
4. National Pipe Hanger Corporation.
5. Pipe Shields Inc.
6. Piping Technology & Products, Inc.
7. Rilco Manufacturing Co., Inc.

B. Insulation-Insert Material for Cold Piping: ASTM C591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength and vapor barrier.

C. Insulation-Insert Material for Hot Piping: ASTM C591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength.

D. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.

E. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.

F. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.6 FASTENER SYSTEMS

A. Mechanical-Expansion Anchors: Insert-wedge-type anchors, for use in hardened portland cement concrete, with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. B-line, an Eaton business.
b. Empire Tool and Manufacturing Co., Inc.
c. Hilti, Inc.
d. ITW Ramset/Red Head; Illinois Tool Works, Inc.

2. Indoor Applications: Zinc-coated steel.
3. Outdoor Applications: Stainless steel.

2.7 PIPE-POSITIONING SYSTEMS

A. Description: IAPMO PS 42 positioning system composed of metal brackets, clips, and straps for positioning piping in pipe spaces; for plumbing fixtures in commercial applications.

2.8 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural-carbon-steel shapes.

2.9 MATERIALS

A. Aluminum: ASTM B221.

B. Carbon Steel: ASTM A1011/A1011M.

C. Structural Steel: ASTM A36/A36M carbon-steel plates, shapes, and bars; black and galvanized.

D. Stainless Steel: ASTM A240/A240M.

E. Grout: ASTM C1107/C1107M, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.

1. Properties: Nonstaining, noncorrosive, and nongaseous.
2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 APPLICATION

A. Comply with requirements in Section 07 84 13 "Penetration Firestopping" for firestopping materials and installation, for penetrations through fire-rated walls, ceilings, and assemblies.

B. Strength of Support Assemblies: Where not indicated, select sizes of components, so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.

3.2 HANGER AND SUPPORT INSTALLATION

A. Metal Pipe-Hanger Installation: Comply with MSS SP-58. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.

B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-58. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.

1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size, or install intermediate supports for smaller-diameter pipes as specified for individual pipe hangers.
2. Field fabricate from ASTM A36/A36M carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.

C. Thermal Hanger-Shield Installation: Install in pipe hanger or shield for insulated piping.

D. Fastener System Installation:

1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete, after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
2. Install mechanical-expansion anchors in concrete, after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

E. Pipe-Positioning-System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture.

F. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.

G. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

H. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

I. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms, and install reinforcing bars through openings at top of inserts.

J. Load Distribution: Install hangers and supports, so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

K. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.

L. Insulated Piping:

1. Attach clamps and spacers to piping.

    a. Piping Operating Above Ambient Air Temperature: Clamp may project through insulation.
    b. Piping Operating Below Ambient Air Temperature: Use thermal hanger-shield insert with clamp sized to match OD of insert.
    c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.

2. Install MSS SP-58, Type 39 protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.

    a. Option: Thermal hanger-shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

3. Install MSS SP-58, Type 40 protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.

    a. Option: Thermal hanger-shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

4. Shield Dimensions for Pipe: Not less than the following:

    a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
    b. NPS 4: 12 inches long and 0.06 inch thick.
    c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
    d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.

5. Pipes NPS 8 and Larger: Include reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.
6. Thermal Hanger Shields: Install with insulation of same thickness as piping insulation.

3.3 EQUIPMENT SUPPORTS

A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.

B. Grouting: Place grout under supports for equipment, and make bearing surface smooth.

C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.4 METAL FABRICATIONS

A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.

B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. Finish welds at exposed connections, so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.5 ADJUSTING

A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.6 PAINTING

A. Touchup: Clean field welds and abraded, shop-painted areas. Paint exposed areas immediately after erecting hangers and supports. Use same materials as those used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.

B. Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded, shop-painted areas on miscellaneous metal are specified in Section 09 96 00 "High-Performance Coatings."

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas, and apply galvanizing-repair paint to comply with ASTM A780/A780M.

3.7 HANGER AND SUPPORT SCHEDULE

A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.

B. Comply with MSS SP-58 for pipe-hanger selections and applications that are not specified in piping system Sections.

C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finishes.

D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

E. Use carbon-steel pipe hangers and supports, metal trapeze pipe hangers, and attachments for general service applications.

F. Use stainless-steel pipe hangers and stainless-steel or corrosion-resistant attachments for hostile environment applications.

G. Use copper-plated pipe hangers and copper attachments for copper piping and tubing.

H. Use padded hangers for piping that is subject to scratching.

I. Use thermal hanger-shield inserts for insulated piping and tubing.

J. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30.
2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg F pipes NPS 4 to NPS 24, requiring up to 4 inches of insulation.
3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36, requiring clamp flexibility and up to 4 inches of insulation.
4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes NPS 1/2 to NPS 24 if little or no insulation is required.
5. Pipe Hangers (MSS Type 5): For suspension of pipes NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes NPS 3/4 to NPS 8.
7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
10. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 8.
11. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 3.
12. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.
13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
14. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
16. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes NPS 2-1/2 to NPS 36 if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.
17. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30, from two rods if longitudinal movement caused by expansion and contraction occurs.
18. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes NPS 2-1/2 to NPS 24, from single rod if horizontal movement caused by expansion and contraction occurs.
19. Complete Pipe Rolls (MSS Type 44): For support of pipes NPS 2 to NPS 42 if longitudinal movement caused by expansion and contraction occurs but vertical adjustment is unnecessary.
20. Pipe Roll and Plate Units (MSS Type 45): For support of pipes NPS 2 to NPS 24 if small horizontal movement caused by expansion and contraction occurs and vertical adjustment is unnecessary.
21. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes NPS 2 to NPS 30 if vertical and lateral adjustment during installation, in addition to expansion and contraction, is required.

K. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.
2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.

L. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel Turnbuckles (MSS Type 13): For adjustment of up to 6 inches for heavy loads.
2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11 split pipe rings.
4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.

M. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel or Malleable-Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape.
3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
6. C-Clamps (MSS Type 23): For structural shapes.
7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
12. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:

    a. Light (MSS Type 31): 750 lb.
    b. Medium (MSS Type 32): 1500 lb.
    c. Heavy (MSS Type 33): 3000 lb.

13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.

N. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.

3. Thermal Hanger-Shield Inserts: For supporting insulated pipe.

O. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
2. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41 roll hanger with springs.
3. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
4. Variable-Spring Hangers (MSS Type 51): Preset to indicated load, and limit variability factor to 25 percent to allow expansion and contraction of piping system from hanger.
5. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load, and limit variability factor to 25 percent to allow expansion and contraction of piping system from base support.
6. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load, and limit variability factor to 25 percent to allow expansion and contraction of piping system from trapeze support.
7. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:

    a. Horizontal (MSS Type 54): Mounted horizontally.
    b. Vertical (MSS Type 55): Mounted vertically.
    c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.

P. Comply with MSS SP-58 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.

Q. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.

R. Use mechanical-expansion anchors instead of building attachments where required in concrete construction.

S. Use pipe-positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

END OF SECTION

SECTION 22 05 48.13 - VIBRATION CONTROLS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Elastomeric isolation pads.
2. Elastomeric isolation mounts.
3. Open-spring isolators.
4. Pipe-riser resilient supports.
5. Elastomeric hangers.
6. Spring hangers.

B. Related Requirements:

1. Section 21 05 48.13 "Vibration Controls for Fire-Suppression Piping and Equipment" for devices for fire-suppression equipment and systems.
2. Section 23 05 48.13 "Vibration Controls for HVAC" for devices for HVAC equipment and systems.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
2. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of vibration isolation device type required.

B. Shop Drawings:

1. Detail fabrication and assembly of equipment bases. Detail fabrication including anchorages and attachments to structure and to supported equipment.

C. Delegated-Design Submittal: For each vibration isolation device.

1. Include design calculations for selecting vibration isolators.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Show coordination of vibration isolation device installation for plumbing piping and equipment with other systems and equipment in the vicinity, including other supports and restraints, if any.

B. Qualification Data: For testing agency.

C. Welding certificates.

1.5 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

PART 2 - PRODUCTS

2.1 ELASTOMERIC ISOLATION PADS

A. Elastomeric Isolation Pads:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Kinetics Noise Control, Inc.
b. Mason Industries, Inc.
c. Vibration Eliminator Co., Inc.

2. Fabrication: Single or multiple layers of sufficient durometer stiffness for uniform loading over pad area.
3. Size: Factory or field cut to match requirements of supported equipment.
4. Pad Material: Oil and water resistant with elastomeric properties.
5. Surface Pattern: Waffle pattern.
6. Infused nonwoven cotton or synthetic fibers.
7. Load-bearing metal plates adhered to pads.
8. Sandwich-Core Material: Resilient and elastomeric.

a. Surface Pattern: Waffle pattern.
b. Infused nonwoven cotton or synthetic fibers.

2.2 ELASTOMERIC ISOLATION MOUNTS

A. Double-Deflection, Elastomeric Isolation Mounts:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Kinetics Noise Control, Inc.
b. Mason Industries, Inc.
c. Vibration Eliminator Co., Inc.

2. Mounting Plates:

a. Top Plate: Encapsulated steel load transfer top plates, factory drilled and threaded with threaded studs or bolts.
b. Baseplate: Encapsulated steel bottom plates with holes provided for anchoring to support structure.

3. Elastomeric Material: Molded, oil-resistant rubber, neoprene, or other elastomeric material.

2.3 OPEN-SPRING ISOLATORS

A. Freestanding, Laterally Stable, Open-Spring Isolators:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Kinetics Noise Control, Inc.
b. Mason Industries, Inc.
c. Vibration Eliminator Co., Inc.

2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
6. Baseplates: Factory-drilled steel plate for bolting to structure with an elastomeric isolator pad attached to the underside. Baseplates shall limit floor load to 500 psig.
7. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.

2.4 PIPE-RISER RESILIENT SUPPORT

A. Description: All-directional, acoustical pipe anchor consisting of two steel tubes separated by a minimum 1/2-inch-thick neoprene.

1. Vertical-Limit Stops: Steel and neoprene vertical-limit stops arranged to prevent vertical travel in both directions.
2. Maximum Load Per Support: 500 psig on isolation material providing equal isolation in all directions.

2.5 ELASTOMERIC HANGERS

A. Elastomeric Mount in a Steel Frame with Upper and Lower Steel Hanger Rods:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Kinetics Noise Control, Inc.
b. Mason Industries, Inc.
c. Vibration Eliminator Co., Inc.

2. Frame: Steel, fabricated with a connection for an upper threaded hanger rod and an opening on the underside to allow for a maximum of 30 degrees of angular lower hanger-rod misalignment without binding or reducing isolation efficiency.
3. Dampening Element: Molded, oil-resistant rubber, neoprene, or other elastomeric material with a projecting bushing for the underside opening preventing steel to steel contact.

2.6 SPRING HANGERS

A. Combination Coil-Spring and Elastomeric-Insert Hanger with Spring and Insert in Compression:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Kinetics Noise Control, Inc.
b. Mason Industries, Inc.
c. Vibration Eliminator Co., Inc.

2. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
7. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.
8. Adjustable Vertical Stop: Steel washer with neoprene washer "up-stop" on lower threaded rod.
9. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and equipment to receive vibration isolation control devices for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 VIBRATION CONTROL DEVICE INSTALLATION

A. Coordinate the location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork specified in Section 03 30 00 "Cast-in-Place Concrete."

B. Installation of vibration isolators must not cause any change of position of equipment, piping, or ductwork resulting in stresses or misalignment.

3.3 VIBRATION CONTROL DEVICE SCHEDULE

A. Provide vibration isolation for equipment as listed in table:

EQUIPMENT	HP	ON GRADE *				ABOVE GRADE			
		Isol	Defl (Inch)	Base	Restr	Isol	Defl (Inch)	Base	Restr
Water Heaters	All	----	----	----	----	----	----	----	----
In-Line Pumps	All	----	----	----	----	EH	0.30	----	----
Base Mounted Pumps	All	OSI	1.00	CIB	----	OSI	2.00	CIB	----

* On Grade refers to slab directly supported by ground.

END OF SECTION

THIS PAGE IS INTENTIONALLY LEFT BLANK.

SECTION 22 05 53 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Equipment labels.
2. Warning signs and labels.
3. Pipe labels.
4. Valve tags.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. LEED Submittals:

1. Product data for Credit IEQ 4.1: For adhesives applied within the building waterproofing envelope, documentation including printed statement of VOC content in g/L.

C. Samples: For color, letter style, and graphic representation required for each identification material and device.

D. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.

E. Valve numbering scheme.

F. Valve Schedules: For each piping system to include in maintenance manuals.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Metal Labels for Equipment:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Brady Corporation.
b. Brimar Industries, Inc.
c. Carlton Industries, LP.
d. Champion America.
e. Craftmark Pipe Markers.
f. emedco.
g. Kolbi Pipe Marker Co.
h. LEM Products Inc.

i. Marking Services, Inc.

2. Material and Thickness: Brass, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
3. Letter Color: Black.
4. Background Color: White.
5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
7. Fasteners: Stainless-steel rivets or self-tapping screws.
8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), and the Specification Section number and title where equipment is specified.

2.2 WARNING SIGNS AND LABELS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Brady Corporation.
2. Brimar Industries, Inc.
3. Carlton Industries, LP.
4. Champion America.
5. Craftmark Pipe Markers.
6. Emedco.
7. LEM Products Inc.
8. Marking Sevices Inc.
9. National Marker Company.
10. Seton Identification Products.

B. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.

C. Letter Color: White.

D. Background Color: Red.

E. Maximum Temperature: Able to withstand temperatures up to 160 deg F.

F. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

G. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.

H. Fasteners: Stainless-steel rivets or self-tapping screws.

I. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

J. Label Content: Include caution and warning information plus emergency notification instructions.

2.3 PIPE LABELS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Actioncraft Products, Inc.; a division of Industrial Test Equipment Co., Inc.
2. Brady Corporation.
3. Brimar Industries, Inc.
4. Carlton Industries, LP.
5. Champion America.
6. Craftmark Pipe Markers.
7. emedco.
8. Kolbi Pipe Marker Co.
9. LEM Products Inc.
10. Marking Sevices Inc.

B. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.

C. Letter and Background Color: As indicated for specific application under Part 3.

D. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.

E. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.

F. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings; also include pipe size and an arrow indicating flow direction.

1. Flow-Direction Arrows: Integral with piping-system service lettering to accommodate both directions or as separate unit on each pipe label to indicate flow direction.
2. Lettering Size: At least 1/2 inch for viewing distances up to 72 inches and proportionately larger lettering for greater viewing distances.

2.4 VALVE TAGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Actioncraft Products, Inc.; a division of Industrial Test Equipment Co., Inc.
2. Brady Corporation.
3. Brimar Industries, Inc.
4. Carlton Industries, LP.
5. Champion America.
6. Craftmark Pipe Markers.
7. emedco.
8. Kolbi Pipe Marker Co.
9. LEM Products Inc.
10. Marking Sevices Inc.

B. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.

1. Tag Material: Brass, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Fasteners: Brass wire-link chain or beaded chain or S-hook.

C. Letter and Background Color: As indicated for specific application under Part 3.

D. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.

1. Valve-tag schedule shall be included in operation and maintenance data.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 GENERAL INSTALLATION REQUIREMENTS

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Coordinate installation of identifying devices with locations of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

D. Locate identifying devices so that they are readily visible from the point of normal approach.

3.3 EQUIPMENT LABEL INSTALLATION

A. Install or permanently fasten labels on each major item of mechanical equipment.

B. Locate equipment labels where accessible and visible.

3.4 PIPE LABEL INSTALLATION

A. Piping Color Coding: Painting of piping is specified in Section 09 96 00 "High-Performance Coatings."

B. Pipe Label Locations: Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:

1. Near each valve and control device.
2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
4. At access doors, manholes, and similar access points that permit view of concealed piping.
5. Near major equipment items and other points of origination and termination.
6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.

7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.
8. Within 2 feet of wall penetration.

C. Directional Flow Arrows: Arrows shall be used to indicate direction of flow in pipes, including pipes where flow is allowed in both directions.

D. Pipe Label Color Schedule:

1. Domestic Cold-Water Piping

   a. Background: Safety green.
   b. Letter Colors: White.

2. Domestic Hot Water Piping

   a. Background: Yellow
   b. Letter Colors: Black

3. Domestic Hot Water Return Piping

   a. Background: Yellow
   b. Letter Colors: Black

4. Sanitary Waste and Vent:

   a. Background: Green
   b. Letters: White

5. Storm Drainage Piping:

   a. Background Color: Green.
   b. Letter Color: White.

3.5 VALVE-TAG INSTALLATION

A. Install tags on valves and control devices in piping systems, except check valves, valves within factory-fabricated equipment units, shutoff valves, faucets, convenience and lawn-watering hose connections, and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.

B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:

1. Valve-Tag Size and Shape:

   a. Cold Water: 1-1/2 inches, round.
   b. Hot Water: 1-1/2 inches, round.

2. Valve-Tag Colors:

   a. Cold Water: Natural.
   b. Hot Water: Natural.

3. Letter Colors:

a. Cold Water: White.
b. Hot Water: White.

END OF SECTION

SECTION 22 05 93 - TESTING, ADJUSTING, AND BALANCING FOR PLUMBING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. TAB of plumbing equipment:

a. Domestic hot-water in-line circulation pumps.
b. Hot water heaters.

2. Pipe-leakage test verification.

3. Testing, adjusting, and balancing of existing plumbing systems and equipment.

1.3 DEFINITIONS

A. AABC: Associated Air Balance Council.

B. NEBB: National Environmental Balancing Bureau.

C. TAB: Testing, adjusting, and balancing.

D. TABB: Testing, Adjusting, and Balancing Bureau.

E. TAB Specialist: An independent entity meeting qualifications to perform TAB work.

F. TDH: Total dynamic head.

1.4 PREINSTALLATION MEETINGS

A. TAB Conference: Conduct a TAB conference at Project site after approval of the TAB strategies and procedures plan, to develop a mutual understanding of the details. Provide a minimum of 14 days' advance notice of scheduled meeting time and location.

1. Minimum Agenda Items:

a. The Contract Documents examination report.
b. The TAB plan.
c. Needs for coordination and cooperation of trades and subcontractors.
d. Proposed procedures for documentation and communication flow.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: Within 60 days of Contractor's Notice to Proceed, submit documentation that the TAB specialist and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.

B. Contract Documents Examination Report: Within 60 days of Contractor's Notice to Proceed, submit the Contract Documents review report, as specified in Part 3.

C. Strategies and Procedures Plan: Within 60 days of Contractor's Notice to Proceed, submit TAB strategies and step-by-step procedures, as specified in "Preparation" Article.

D. System Readiness Checklists: Within [30] 60 days of Contractor's Notice to Proceed, submit system readiness checklists, as specified in "Preparation" Article.

E. Examination Report: Submit a summary report of the examination review required in "Examination" Article.

F. Certified TAB reports.

G. Sample report forms.

H. Instrument calibration reports, to include the following:

1. Instrument type and make.
2. Serial number.
3. Application.
4. Dates of use.
5. Dates of calibration.

1.6 QUALITY ASSURANCE

A. TAB Specialists Qualifications, Certified by AABC or NEBB:

1. TAB Field Supervisor: Employee of the TAB specialist and certified by AABC or NEBB.
2. TAB Technician: Employee of the TAB specialist and certified by AABC or NEBB.

B. Instrumentation Type, Quantity, Accuracy, and Calibration: Comply with requirements in ASHRAE 111, Section 4, "Instrumentation."

C. ASHRAE 111 Compliance: Requirements in ASHRAE 111 applicable to analogous domestic water system and plumbing equipment balancing.

D. ASHRAE 188 Compliance: Comply with balancing and report requirements, Section 8.3 "Balancing."

E. Code and Authorities Having Jurisdiction Compliance: TAB is required to comply with governing codes and requirements of authorities having jurisdiction.

1.7 FIELD CONDITIONS

A. Partial Owner Occupancy: Owner may occupy completed areas of building before Substantial Completion. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems designs that may preclude proper TAB of systems and equipment.

B. Examine installed systems for balancing devices, such as test ports, gauge cocks, thermometer wells, flow-control devices, and balancing valves and fittings. Verify that locations of these balancing devices are applicable for intended purpose and are accessible.

C. Examine approved submittals for plumbing systems and equipment.

D. Examine design data, including plumbing system descriptions, statements of design assumptions for environmental conditions and systems output, and statements of philosophies and assumptions about plumbing system and equipment controls.

E. Examine equipment performance data, including pump curves.

1. Relate performance data to Project conditions and requirements, including pump system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
2. Calculate pump system-effect factors to reduce performance ratings of plumbing equipment when installed under conditions different from the conditions used to rate equipment performance. Compare results with the design data and installed conditions.

F. Examine system and equipment installations, and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.

G. Examine test reports specified in individual system and equipment Sections.

H. Examine plumbing equipment and verify that bearings are greased, belts are aligned and tight, filters are clean, and equipment with functioning controls is ready for operation.

I. Examine temporary and permanent strainers. Verify that temporary strainer screens used during system cleaning and flushing have been removed and permanent strainers are installed and clean.

J. Examine control valves for proper installation for their intended function of isolating, throttling, diverting, or mixing fluid flows.

K. Examine system pumps to ensure absence of entrained air in the suction piping.

L. Examine operating safety interlocks and controls on plumbing equipment.

M. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.2 PREPARATION

A. Prepare a TAB plan that includes the following:

1. Equipment and systems to be tested.
2. Strategies and step-by-step procedures for balancing the systems.
3. Instrumentation to be used.
4. Sample forms with specific identification for all equipment.

B. Perform system-readiness checks of plumbing systems and equipment to verify system readiness for TAB work. Include, at a minimum, the following:

1. Domestic Water System:

a. Verify leakage and pressure tests on water distribution systems have been satisfactorily completed in accordance with applicable code and authority having jurisdiction.
b. Water heaters are installed and functioning.
c. Piping is complete and all points of outlet are installed.
d. Systems are flushed, filled, and air purged.
e. Strainers are clean.
f. Control valves are functioning in accordance with the sequence of operation.
g. Shutoff and balance valves are 100 percent open.
h. Hot-water circulating pumps are operational and proper rotation is verified.
i. Pump gauge connections are installed directly at pump inlet and outlet flanges or in discharge and suction pipe prior to valves or strainers.
j. Suitable access to balancing devices and equipment is provided.

3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

A. Perform testing and balancing procedures on each system in accordance with the procedures contained in AABC's "National Standards for Total System Balance" or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" and in this Section.

B. Cut insulation, pipes, and equipment casings for installation of test probes to the minimum extent necessary for TAB procedures.

1. Where holes for probes are required in piping or equipment, install pressure and temperature test plugs to seal systems.
2. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish in accordance with Section 220716 "Plumbing Equipment Insulation" and Section 220719 "Plumbing Piping Insulation."

C. Mark equipment and balancing devices, including valve position indicators and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.

D. Take and report testing and balancing measurements in inch-pound (IP) units.

3.4 GENERAL PROCEDURES FOR PLUMBING EQUIPMENT

A. Test, adjust, and balance plumbing equipment indicated on Drawings, including, but not limited to, the following:

1. Motors.
2. Domestic water in-line pumps.
3. Domestic water heaters.

3.5 PROCEDURES FOR DOMESTIC WATER SYSTEMS

A. Prepare test reports for pumps and other equipment. Obtain approved submittals and manufacturer-recommended testing procedures. Crosscheck the summation of required equipment flow rates with system design flow rates.

B. Prepare schematic diagrams of systems' Record drawings piping layouts.

C. In addition to requirements in "Preparation" Article, prepare domestic water systems for testing and balancing as follows:

1. Check water heater for proper discharge temperature setting.
2. Check remotest point of outlet for adequate pressure.
3. Check flow-control valves for proper position.
4. Locate start-stop and disconnect switches, electrical interlocks, and motor controllers.
5. Verify that motor controllers are equipped with properly sized thermal protection.
6. Check that air has been purged from the system.

D. Measure and record upstream and downstream pressure of each piece of equipment.

E. Measure and record upstream and downstream pressure of pressure-reducing valves.

F. Check settings and operation of automatic temperature-control valves, self-contained control valves, and pressure-reducing valves. Record final settings.

G. Check settings and operation of each safety valve. Record settings.

3.6 PROCEDURES FOR DOMESTIC HOT-WATER CIRCULATING INLINE PUMP

A. Balance system with manual or automatic balancing valves by setting at design flow.

1. Measure flow in main and branch pipes.
2. Adjust main and branch balance valves for design flow.
3. Re-measure each main and branch after all have been adjusted.

B. Adjust pump to deliver total design flow.

1. Measure pump TDH as follows:

a. Measure discharge pressure directly at the pump outlet flange or in discharge pipe prior to any valves.
b. Measure inlet pressure directly at the pump inlet flange or in suction pipe prior to any valves or strainers.
c. Convert pressure to head and correct for differences in gauge heights.

d. Verify pump impeller size by measuring the TDH with the discharge valve closed. Note the point on manufacturer's pump curve at zero flow, and verify that the pump has the intended impeller size.

2. Monitor motor performance during procedures, and do not operate motor in an overloaded condition.
3. Mark final settings and verify that all memory stops have been set.
4. Verify final system conditions as follows:

   a. Re-measure and confirm that total flow is within design.
   b. Re-measure final pumps' operating data, TDH, volts, amps, speed, and static profile.
   c. Mark final settings.

3.7 PROCEDURES FOR MOTORS

A. Motors 1/2 HP and Larger: Test at final balanced conditions and record the following data:

1. Manufacturer's name, model number, and serial number.
2. Motor horsepower rating.
3. Motor rpm.
4. Phase and hertz.
5. Nameplate and measured voltage, each phase.
6. Nameplate and measured amperage, each phase.
7. Starter size and thermal-protection-element rating.
8. Service factor and frame size.

3.8 PROCEDURES FOR WATER HEATERS

A. Electric Water Heaters:

1. Measure and record entering- and leaving-water temperatures.
2. Measure and record water flow.
3. Measure and record pressure drop.
4. Measure and Record relief valve(s) pressure setting.
5. Capacity: Calculate in Btu/h of heating output.
6. Efficiency: Calculate operating efficiency for comparison to submitted equipment.

3.9 TOLERANCES

A. Set plumbing system's flow rates within the following tolerances:

1. Domestic Water Flow Rate: Plus or minus 10 percent.

3.10 PROGRESS REPORTING

A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for system-balancing devices. Recommend changes and additions to system-balancing devices, to facilitate proper performance measuring and balancing. Recommend changes and additions to plumbing systems and general construction to allow access for performance-measuring and -balancing devices.

B. Status Reports: Prepare monthly progress reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.

3.11 FINAL REPORT

A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.

1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
2. Include a list of instruments used for procedures, along with proof of calibration.
3. Certify validity and accuracy of field data.

B. Final Report Contents: In addition to certified field-report data, include the following:

1. Pump curves.
2. Manufacturers' test data.
3. Field test reports prepared by system and equipment installers.
4. Other information relative to equipment performance; do not include Shop Drawings and Product Data.

C. General Report Data: In addition to form titles and entries, include the following data:

1. Title page.
2. Name and address of the TAB specialist.
3. Project name.
4. Project location.
5. Architect's name and address.
6. Engineer's name and address.
7. Contractor's name and address.
8. Report date.
9. Signature of TAB supervisor who certifies the report.
10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
11. Summary of contents, including the following:

    a. Indicated versus final performance.
    b. Notable characteristics of systems.
    c. Description of system operation sequence if it varies from the Contract Documents.

12. Nomenclature sheets for each item of equipment.
13. Notes to explain why certain final data in the body of reports vary from indicated values.
14. Test conditions for pump performance forms, including the following:

    a. Variable-frequency controller settings for variable-flow hydronic systems.
    b. Settings for pressure controller(s).
    c. Other system operating conditions that affect performance.

D. System Diagrams: Include schematic layouts of distribution systems. Present each system with single-line diagram and include the following:

1. Flow rates.

2. Pipe and valve sizes and locations.
3. Balancing stations.
4. Position of balancing devices.

E. Electric Water Heater Test Reports: In addition to manufacturer's factory startup equipment reports, include the following:

1. Unit Data:

   a. System identification.
   b. Location.
   c. Model number and unit size.
   d. Manufacturer's serial number.
   e. Output capacity in Btu/h.
   f. Number of stages.
   g. Connected volts, phase, and hertz.
   h. Rated amperage.

2. Test Data (Indicated and Actual Values):

   a. Heat output in Btu/h.
   b. Entering-water temperature in deg F.
   c. Leaving-water temperature in deg F.
   d. High-temperature-limit setting in deg F.
   e. Operating set point in deg F.
   f. Voltage at each connection.
   g. Amperage for each phase.

F. Pump Test Reports: Calculate impeller size by plotting the shutoff head on pump curves, and include the following:

1. Unit Data:

   a. Unit identification.
   b. Location.
   c. Service.
   d. Make and size.
   e. Model number and serial number.
   f. Water flow rate in gpm.
   g. Water-pressure differential in feet of head or psig.
   h. Required net positive suction head in feet of head or psig.
   i. Pump speed.
   j. Impeller diameter in inches.
   k. Motor make and frame size.
   l. Motor horsepower and rpm.
   m. Voltage at each connection.
   n. Amperage for each phase.
   o. Full-load amperage and service factor.
   p. Seal type.

2. Test Data (Indicated and Actual Values):

   a. Static head in feet of head or psig.
   b. Pump shutoff pressure in feet of head or psig.
   c. Actual impeller size in inches.

d. Full-open flow rate in gpm.
e. Full-open pressure in feet of head or psig.
f. Final discharge pressure in feet of head or psig.
g. Final suction pressure in feet of head or psig.
h. Final total pressure in feet of head or psig.
i. Final water flow rate in gpm.
j. Voltage at each connection.
k. Amperage for each phase.

G. Instrument Calibration Reports:

1. Report Data:

a. Instrument type and make.
b. Serial number.
c. Application.
d. Dates of use.
e. Dates of calibration.

3.12 VERIFICATION OF TAB REPORT

A. The TAB specialist's test and balance engineer shall conduct the inspection in the presence of Owner or Commissioning Authority.

B. Owner or Commissioning Authority shall randomly select measurements, documented in the final report, to be rechecked. Rechecking shall be limited to 10 percent of the total measurements recorded.

C. If rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."

D. If the number of "FAILED" measurements is greater than 20 percent of the total measurements checked during the final inspection, the TAB shall be considered incomplete and shall be rejected.

E. If recheck measurements find the number of failed measurements noncompliant with requirements indicated, proceed as follows:

1. TAB specialists shall recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes; resubmit the final report and request a second final inspection. All changes shall be tracked to show changes made to previous report.
2. If the second final inspection also fails, Owner may pursue other Contract options to complete TAB work.

F. Prepare test and inspection reports.

END OF SECTION

THIS PAGE IS INTENTIONALLY LEFT BLANK.

SECTION 22 07 16 - PLUMBING EQUIPMENT INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes insulating the following plumbing equipment that is not factory insulated:

1. Domestic water storage tanks.

B. Related Sections:

1. Section 220719 "Plumbing Piping Insulation."

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory and field applied, if any).

B. Sustainable Design Submittals:

1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.
2. Product Data: For adhesives, mastics, and sealants, indicating VOC content.
3. Laboratory Test Reports: For adhesives, mastics, and sealants, indicating compliance with requirements for low-emitting materials.

C. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. Detail removable insulation at equipment connections.
2. Detail application of field-applied jackets.
3. Detail application at linkages of control devices.
4. Detail field application for each equipment type.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.

C. Field quality-control reports.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation system materials are to be delivered to the Project site in unopened containers. The packaging is to include, the name of the manufacturer, fabricator, type, description, and size, as well as ASTM standard designation, and maximum use temperature.

1.6 COORDINATION

A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."

B. Coordinate clearance requirements with equipment Installer for equipment insulation application.

1.7 SCHEDULING

A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products in accordance with ASTM E84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation, jacket materials, adhesive, mastic, tapes, and cement material containers with appropriate markings of applicable testing agency.

1. All Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.

2.2 INSULATION MATERIALS

A. Products do not contain asbestos, lead, mercury, or mercury compounds.

B. Products that come into contact with stainless steel have a leachable chloride content of less than 50 ppm when tested in accordance with ASTM C871.

C. Insulation materials for use on austenitic stainless steel are qualified as acceptable in accordance with ASTM C795.

D. Foam insulation materials do not use CFC or HCFC blowing agents in the manufacturing process.

E. Cellular Glass: Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells. Comply with ASTM C552.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
   a. Owens Corning.
2. Block Insulation: Type I.
3. Special-Shaped Insulation: Type III.
4. Board Insulation: Type IV.
5. Factory fabricate shapes in accordance with ASTM C450 and ASTM C585.
6. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

F. Flexible Elastomeric: Closed-cell or expanded-rubber materials; suitable for maximum use temperature between minus 70 deg F and 220 deg F. Comply with ASTM C534/C534M, Type II for sheet materials.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Aeroflex USA.
   b. Armacell LLC.
   c. K-Flex USA.

G. Glass-Fiber, Pipe and Tank: Glass fibers bonded with a thermosetting resin; suitable for maximum use temperature between 35 deg F and 850 deg F, in accordance with ASTM C411. Comply with ASTM C1393.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Certainteed; SAINT-GOBAIN.
   b. Johns Manville; a Berkshire Hathaway company.
   c. Knauf Insulation.
   d. Manson Insulation Inc.
   e. Owens Corning.

2. Semirigid board material with factory-applied ASJ jacket.
3. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

2.3 ADHESIVES

A. Materials are compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.

B. Cellular-Glass Adhesive: Two-component, thermosetting urethane adhesive containing no flammable solvents, with a service temperature range of minus 100 to plus 200 deg F.

1. Adhesive: As recommended by cellular glass manufacturer and with a VOC content of 80 g/L or less.

2. Verify adhesive complies with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

C. Flexible Elastomeric and Polyolefin Adhesive: Solvent-based adhesive.

1. Adhesive: As recommended by flexible elastomeric and polyolefin manufacturer and with a VOC content of 80 g/L or less.
2. Verify adhesive complies with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
3. Flame-spread index is 25 or less and smoke-developed index is 50 or less as tested in accordance with ASTM E84.
4. Wet Flash Point: Below 0 deg F
5. Service Temperature Range: 40 to 200 deg F.
6. Color: Black.

D. Glass-Fiber and Mineral Wool Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

1. Adhesive: As recommended by mineral fiber manufacturer and with a VOC content of 80 g/L or less.
2. Verify adhesive complies with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

E. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

1. Verify adhesives have a VOC content of 50 g/L or less.
2. Verify adhesive complies with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

F. PVC Jacket Adhesive: Compatible with PVC jacket.

1. Adhesive: As recommended by Adhesive - PVC Jacket manufacturer and with a VOC content of 50 g/L or less.
2. Verify adhesive complies with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

2.4 MASTICS AND COATINGS

A. Materials are compatible with insulation materials, jackets, and substrates.

1. Mastics: As recommended by insulation manufacturer and with a VOC content of 50 g/L or less.
2. Verify mastics comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

B. Vapor-Retarder Mastic, Water Based: Suitable for indoor use on below-ambient services.

1. Water-Vapor Permeance: Comply with ASTM E96/E96M or ASTM F1249.
2. Service Temperature Range: 0 to plus 180 deg F.
3. Comply with MIL-PRF-19565C, Type II, for permeance requirements.
4. Color: White.

2.5 LAGGING ADHESIVES

A. Description: Comply with MIL-A-3316C, Class I, Grade A, and be compatible with insulation materials, jackets, and substrates.

1. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over insulation.
2. Service Temperature Range: 20 to plus 180 deg F.
3. Color: White.

2.6 SEALANTS

A. Materials are as recommended by the insulation manufacturer and are compatible with insulation materials, jackets, and substrates.

B. Joint Sealants:

1. Permanently flexible, elastomeric sealant.
2. Service Temperature Range: Minus 100 to plus 300 deg F.
3. Color: White or gray.

C. ASJ Flashing Sealants:

1. Fire- and water-resistant, flexible, elastomeric sealant.
2. Service Temperature Range: Minus 40 to plus 250 deg F.
3. Color: White.

2.7 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C1136, Type I.

2.8 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C1136.

1. Width: 3 inches.
2. Thickness: 11.5 mils.
3. Adhesion: 90 ounces force/inch in width.
4. Elongation: 2 percent.
5. Tensile Strength: 40 lbf/inch in width.
6. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

2.9 SECUREMENTS

A. Bands:

1. Stainless Steel: ASTM A240/A240M, Type 304 or Type 316; 0.015 inch thick, 3/4 inch wide with wing seal or closed seal.
2. Springs: Twin spring set constructed of stainless steel with ends flat and slotted to accept metal bands. Spring size is determined by manufacturer for application.

B. Insulation Pins and Hangers:

1. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place.

    a. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
    b. Spindle: Stainless steel, fully annealed, 0.106-inch-diameter shank; length to suit depth of insulation indicated.
    c. Adhesive: Recommended by hanger manufacturer. Use product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.

2. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick, stainless steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.

    a. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.

C. Staples: Outward-clinching insulation staples, nominal 3/4-inch-wide, stainless steel or Monel.

D. Wire: 0.062-inch soft-annealed, stainless steel.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.

1. Verify that systems and equipment to be insulated have been tested and are free of defects.

2. Verify that surfaces to be insulated are clean and dry.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

B. Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:

1. Carbon Steel: Coat carbon steel operating at a service temperature between 32 and 300 deg F with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.

C. Coordinate insulation installation with the tradesman installing heat tracing. Comply with requirements for heat tracing that apply to insulation.

D. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless steel surfaces, use demineralized water.

3.3 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment.

B. Install insulation materials, forms, vapor barriers or retarders, jackets, and of thicknesses required for each item of equipment, as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Keep insulation materials dry during storage, application, and finishing. Replace insulation materials that get wet during storage or in the installation process before being properly covered and sealed in accordance with Contract Documents.

G. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

H. Install insulation with least number of joints practical.

I. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

1. Install insulation continuously through hangers and around anchor attachments.
2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends attached to structure with vapor-barrier mastic.
3. Install insert materials and insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
4. Cover inserts with jacket material matching adjacent insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

J. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

K. Cut insulation in a manner to avoid compressing insulation.

L. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

M. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches in similar fashion to butt joints.

3.4 INSTALLATION OF EQUIPMENT, TANK, AND VESSEL INSULATION

A. Glass-Fiber, Pipe and Tank Insulation Installation for Tanks and Vessels: Secure insulation with adhesive and anchor pins and speed washers.

1. Apply adhesives in accordance with manufacturer's recommended coverage rates per unit area, for 100 percent coverage of tank and vessel surfaces.
2. Groove and score insulation materials to fit as closely as possible to equipment, including contours. Bevel insulation edges for cylindrical surfaces for tight joints. Stagger end joints.
3. Protect exposed corners with secured corner angles.
4. Install adhesively attached or self-sticking insulation hangers and speed washers on sides of tanks and vessels as follows:

    a. Do not weld anchor pins to ASME-labeled pressure vessels.
    b. Select insulation hangers and adhesive that are compatible with service temperature and with substrate.
    c. On tanks and vessels, maximum anchor-pin spacing is 3 inches from insulation end joints and 16 inches o.c. in both directions.
    d. Do not compress insulation during installation.
    e. Cut and miter insulation segments to fit curved sides and domed heads of tanks and vessels.
    f. Impale insulation over anchor pins, and attach speed washers.
    g. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

5. Secure each layer of insulation with stainless steel or aluminum bands. Select band material compatible with insulation materials.

6. Where insulation hangers on equipment and vessels are not permitted or practical and where insulation support rings are not provided, install a girdle network for securing insulation. Stretch prestressed aircraft cable around the diameter of vessel and make taut with clamps, turnbuckles, or breather springs. Place one circumferential girdle around equipment approximately 6 inches from each end. Install wire or cable between two circumferential girdles 12 inches o.c. Install a wire ring around each end and around outer periphery of center openings, and stretch prestressed aircraft cable radially from the wire ring to nearest circumferential girdle. Install additional circumferential girdles along the body of equipment or tank at a minimum spacing of 48 inches o.c. Use this network for securing insulation with tie wire or bands.
7. Stagger joints between insulation layers at least 3 inches.
8. Install insulation in removable and replaceable segments on equipment access doors, manholes, handholes, and other elements that require frequent removal for service and inspection.
9. Bevel and seal insulation ends around manholes, handholes, ASME stamps, and nameplates.
10. For equipment with surface temperatures below ambient, apply mastic to open ends, joints, seams, breaks, and punctures in insulation.

B. Flexible Elastomeric Thermal Insulation Installation for Tanks and Vessels: Install insulation over entire surface of tanks and vessels.

1. Apply 100 percent coverage of adhesive to surface with manufacturer's recommended adhesive.
2. Seal longitudinal seams and end joints.

3.5 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

A. Install in accordance with manufacturer's written installation instructions and ASTM C1710.

B. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.6 FINISHES

A. Equipment Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.

a. Finish Coat Material: Interior, flat, latex-emulsion size.

B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.

C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

D. Do not field paint aluminum or stainless steel jackets.

3.7 FIELD QUALITY CONTROL

A. Owner will engage a qualified testing agency to perform tests and inspections.

B. Engage a qualified testing agency to perform tests and inspections.

C. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

D. Perform tests and inspections.

E. Tests and Inspections: Inspect field-insulated equipment, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection is limited to one location(s) for each type of equipment defined in the "Indoor Equipment Insulation Schedule" Article. For large equipment, remove only a portion adequate to determine compliance.

F. All insulation applications will be considered defective if they do not pass tests and inspections.

G. Prepare test and inspection reports.

3.8 INDOOR EQUIPMENT INSULATION SCHEDULE

A. Insulate indoor and outdoor equipment that is not factory insulated.

B. Domestic water storage tank insulation is one of the following:

1. Cellular Glass: 2 inches thick.
2. Flexible Elastomeric: 1 inch thick.
3. Glass-Fiber Pipe and Tank: 1 inch thick.

END OF SECTION

SECTION 22 07 19 - PLUMBING PIPING INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes insulating the following plumbing piping services:

1. Domestic cold-water piping.
2. Domestic hot-water piping.
3. Domestic recirculating hot-water piping.
4. Storm-water and secondary storm water piping.
5. Roof drains and rainwater leaders.
6. Supplies and drains for handicap-accessible lavatories and sinks.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory and field applied if any).

B. Sustainable Design Submittals:

1. Product Data: For adhesives, mastics, and sealants, indicating VOC content.
2. Laboratory Test Reports: For adhesives, mastics, and sealants, indicating compliance with requirements for low-emitting materials.

C. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
2. Detail attachment and covering of heat tracing inside insulation.
3. Detail insulation application at pipe expansion joints for each type of insulation.
4. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
5. Detail removable insulation at piping specialties, equipment connections, and access panels.
6. Detail application of field-applied jackets.
7. Detail application at linkages of control devices.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.

C. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.7 COORDINATION

A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 22 05 29 "Hangers and Supports for Plumbing Piping and Equipment."

B. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

1.8 SCHEDULING

A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products in accordance with ASTM E84 by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less and smoke-developed index of 50 or less.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less and smoke-developed index of 150 or less.

B. Comply with the following applicable standards and other requirements specified for miscellaneous components:

1. Supply and Drain Protective Shielding Guards: ICC A117.1.

2.2 INSULATION MATERIALS

A. Comply with requirements in "Piping Insulation Schedule, General," "Indoor Piping Insulation Schedule," "Outdoor, Aboveground Piping Insulation Schedule," and "Outdoor, Underground Piping Insulation Schedule" articles for where insulating materials shall be applied.

B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Products that come into contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested in accordance with ASTM C871.

D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable in accordance with ASTM C795.

E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

F. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C534/C534M, Type I for tubular materials.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Aeroflex USA, Inc.
b. Armacell LLC.
c. K-Flex.

G. Mineral-Fiber, Preformed Pipe: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C547.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Johns Manville; a Berkshire Hathaway company.
b. Knauf Insulation.
c. Manson Insulation Inc.

2. Preformed Pipe Insulation: Type I, Grade A, with factory-applied ASJ.
3. 850 deg F.
4. Factory fabricate shapes in accordance with ASTM C450 and ASTM C585.
5. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

2.3 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.

B. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Aeroflex USA, Inc.
b. Armacell LLC.
c. Foster Brand; H. B. Fuller Construction Products.

2. Adhesive: As recommended by flexible elastomeric and polyolefin manufacturer and with a VOC content of 80 g/L or less.

C. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Childers Brand; H. B. Fuller Construction Products.
b. Eagle Bridges - Marathon Industries.
c. Foster Brand; H. B. Fuller Construction Products.

2. Adhesive: As recommended by mineral fiber manufacturer and with a VOC content of 80 g/L or less.

D. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Childers Brand; H. B. Fuller Construction Products.
b. Eagle Bridges - Marathon Industries.
c. Foster Brand; H. B. Fuller Construction Products.

2. Adhesives shall have a VOC content of 80 g/L or less.

E. PVC Jacket Adhesive: Compatible with PVC jacket.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Dow Corning Corporation.
b. Johns Manville; a Berkshire Hathaway company.
c. P.I.C. Plastics, Inc.

2. Adhesive: As recommended by Adhesive - PVC Jacket manufacturer and with a VOC content of 50 g/L or less.

2.4 MASTICS AND COATINGS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.

1. Mastics: As recommended by insulation manufacturer and with a VOC content of 50 g/L or less.

B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below-ambient services.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Childers Brand; H. B. Fuller Construction Products.
b. Foster Brand; H. B. Fuller Construction Products.
c. Knauf Insulation.

2. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm at 43-mil dry film thickness.
3. Service Temperature Range: Minus 20 to plus 180 deg F.
4. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
5. Color: White.

2.5 LAGGING ADHESIVES

A. Description: Comply with MIL-A-3316C, Class I, Grade A, and shall be compatible with insulation materials, jackets, and substrates.

1. Retain first subparagraph below if low-emitting materials are required. Consult lagging adhesive manufacturers to determine VOC limits.
2. For indoor applications, use lagging adhesives that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
3. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Childers Brand; H. B. Fuller Construction Products.
    b. Foster Brand; H. B. Fuller Construction Products.
    c. GLT Products.

4. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over pipe insulation.
5. Service Temperature Range: 0 to plus 180 deg F.
6. Color: White.

2.6 SEALANTS

A. Materials shall be as recommended by the insulation manufacturer and shall be compatible with insulation materials, jackets, and substrates.

B. Joint Sealants:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Childers Brand; H. B. Fuller Construction Products.
    b. Foster Brand; H. B. Fuller Construction Products.
    c. Mon-Eco Industries, Inc.

2. Permanently flexible, elastomeric sealant.
3. Service Temperature Range: Minus 58 to plus 176 deg F.
4. Color: White or gray.
5. Sealant shall have a VOC content of 420 g/L or less.

2.7 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C1136, Type I.
2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C1136, Type I.
3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C1136, Type II.

2.8 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

B. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Johns Manville; a Berkshire Hathaway company.
   b. P.I.C. Plastics, Inc.
   c. Proto Corporation.

2. Adhesive: As recommended by jacket material manufacturer.
3. Color: White.
4. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.

   a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.

2.9 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C1136.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. 3M Industrial Adhesives and Tapes Division.
   b. Avery Dennison Corporation, Specialty Tapes Division.
   c. Ideal Tape Co., Inc., an American Biltrite Company.

2. Width: 3 inches.
3. Thickness: 11.5 mils.
4. Adhesion: 90 ounces force/inch in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

2.10 SECUREMENTS

A. Bands:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. ITW Insulation Systems; Illinois Tool Works, Inc.
b. Ellsworth Adhesives
c. National Polymer

2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316; 0.015 inch thick, 1/2 inch wide with wing seal.

B. Staples: Outward-clinching insulation staples, nominal 3/4-inch-wide, stainless steel or Monel.

C. Wire:0.062-inch,soft-annealed,stainless steel.http://www.specagent.com/LookUp/?ulid=1926&mf=04&src=wd

2.11 PROTECTIVE SHIELDING GUARDS

A. Protective Shielding Pipe Covers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Buckaroos, Inc.
b. Engineered Brass Company.
c. Insul-Tect Products Co.
d. McGuire Manufacturing.
e. Plumberex Specialty Products, Inc.
f. Truebro.

2. Description: Manufactured plastic wraps for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with Americans with Disabilities Act (ADA) requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.

1. Verify that systems to be insulated have been tested and are free of defects.
2. Verify that surfaces to be insulated are clean and dry.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

B. Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:

1. Stainless Steel: Coat 300 series stainless steel with an epoxy primer 5 mils thick and an epoxy finish 5 mils thick if operating in a temperature range of between 140 and 300 deg F. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
2. Carbon Steel: Coat carbon steel operating at a service temperature of between 32 and 300 deg F with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.

C. Coordinate insulation installation with the tradesman installing heat tracing. Comply with requirements for heat tracing that apply to insulation.

D. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless steel surfaces, use demineralized water.

3.3 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping, including fittings, valves, and specialties.

B. Install insulation materials, forms, vapor barriers or retarders, jackets, and of thicknesses required for each item of pipe system, as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

G. Keep insulation materials dry during storage, application, and finishing. Replace insulation materials that get wet.

H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

I. Install insulation with least number of joints practical.

J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

1. Install insulation continuously through hangers and around anchor attachments.
2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends attached to structure with vapor-barrier mastic.
3. Install insert materials and insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

L. Install insulation with factory-applied jackets as follows:

1. Draw jacket tight and smooth.
2. Cover circumferential joints with 3-inch-wide strips, of same material as insulation jacket. Secure strips with adhesive and outward-clinching staples along both edges of strip, spaced 4 inches o.c.
3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward-clinching staples along edge at 4 inches o.c.

    a. For below-ambient services, apply vapor-barrier mastic over staples.

4. Cover joints and seams with tape, in accordance with insulation material manufacturer's written instructions, to maintain vapor seal.
5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.

M. Cut insulation in a manner to avoid compressing insulation more than 25 percent of its nominal thickness.

N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least [4 inches] <Insert value> beyond damaged areas. Adhere, staple, and seal patches in similar fashion to butt joints.

P. For above-ambient services, do not install insulation to the following:

1. Vibration-control devices.
2. Testing agency labels and stamps.
3. Nameplates and data plates.
4. Cleanouts.

3.4 PENETRATIONS

A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
4. Seal jacket to roof flashing with flashing sealant.

B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.

C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
4. Seal jacket to wall flashing with flashing sealant.

D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.

1. Comply with requirements in Section 07 84 13 "Penetration Firestopping" for firestopping and fire-resistive joint sealers.

F. Insulation Installation at Floor Penetrations:

1. Pipe: Install insulation continuously through floor penetrations.
2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 07 84 13 "Penetration Firestopping."

3.5 GENERAL PIPE INSULATION INSTALLATION

A. Requirements in this article generally apply to all insulation materials, except where more specific requirements are specified in various pipe insulation material installation articles.

B. Insulation Installation on Fittings, Valves, Strainers, Flanges, Mechanical Couplings, and Unions:

1. Install insulation over fittings, valves, strainers, flanges, mechanical couplings, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
2. Insulate pipe elbows using preformed fitting insulation made from same material and density as that of adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
3. Insulate tee fittings with preformed fitting insulation of same material and thickness as that used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
4. Insulate valves using preformed fitting insulation of same material, density, and thickness as that used for adjacent pipe. Overlap adjoining pipe insulation by not less than 2 times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
5. Insulate strainers using preformed fitting insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than 2 times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers, so strainer basket flange

or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.

6. Insulate flanges, mechanical couplings, and unions, using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than 2 times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Stencil or label the outside insulation jacket of each union with the word "union" matching size and color of pipe labels.
7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
8. For services not specified to receive a field-applied jacket, except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing, using PVC tape.
9. Label the outside insulation jacket of each union with the word "union." Match size and color of pipe labels.

C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

D. Install removable insulation covers at locations indicated. Installation shall conform to the following:

1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as that of adjoining pipe insulation.
2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union at least 2 times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless steel or aluminum bands. Select band material compatible with insulation and jacket.
3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.
4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.6 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:

1. Install pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.

3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as that of pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install mitered sections of pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed valve covers manufactured of same material as that of pipe insulation when available.
2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties, and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.7 INSTALLATION OF MINERAL-FIBER INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of preformed pipe insulation to pipe with wire or bands, and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above-ambient surfaces, secure laps with outward-clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets on below-ambient surfaces, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive, as recommended by insulation material manufacturer, and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as that of straight segments of pipe insulation when available.

2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:
1. Install preformed sections of same material as that of straight segments of pipe insulation when available.
2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

3.8 FIELD-APPLIED JACKET INSTALLATION

A. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints. Seal with manufacturer's recommended adhesive.

1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.
2. Provide PVC jacketing on all insulated piping exposed in mechanical equipment rooms or unfinished spaces below 8’-0” above finished floor.

3.9 FINISHES

A. Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Section 09 91 13 "Exterior Painting" and Section 09 91 23 "Interior Painting."

1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.

a. Finish Coat Material: Interior, flat, latex-emulsion size.

B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.

C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

D. Do not field paint aluminum or stainless-steel jackets.

3.10 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

1. Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations of threaded strainers, two locations of welded strainers, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.

C. All insulation applications will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

3.11 PIPING INSULATION SCHEDULE, GENERAL

A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.

B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:

1. Underground piping.
2. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.12 INDOOR PIPING INSULATION SCHEDULE

A. Domestic Cold Water:

1. NPS 1-1/4 and Smaller: Insulation shall be the following:

a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

2. NPS 1-1/2 and Larger: Insulation shall be the following:

a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1-1/2 inch thick.

B. Domestic Hot and Recirculated Hot Water:

1. NPS 1-1/4 and Smaller: Insulation shall be the following:

a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

2. NPS 1-1/2 and Larger: Insulation shall be the following:

a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1-1/2 inch thick.

C. Stormwater and Overflow:

1. All Pipe Sizes: Insulation shall be the following:

a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
b. Insulate horizontal piping and riser from drain bodies to horizontal piping.

D. Roof Drain and Overflow Drain Bodies:

1. All Pipe Sizes: Insulation shall be the following:

a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
b. Insulate drain bodies and drain riser to horizontal piping.

E. Exposed Sanitary Drains, Domestic Water, Domestic Hot Water, and Stops for Plumbing Fixtures for People with Disabilities:

1. All Pipe Sizes: Insulation shall be one of the following:

    a. Flexible Elastomeric: 3/4 inch thick.
    b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1/2 inch thick.

F. Floor Drains, Traps, and Sanitary Drain Piping within 10 Feet of Drain Receiving Condensate and Equipment Drain Water below 60 Deg F:

1. All Pipe Sizes: Insulation shall be one of the following:

    a. Flexible Elastomeric: 3/4 inch thick.
    b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1/2 inch thick.

G. Hot Service Drains:

1. All Pipe Sizes: Insulation shall be the following:

    a. Mineral-Fiber, Preformed Pipe, Type I: 1 inch thick.

H. Hot Service Vents:

1. All Pipe Sizes: Insulation shall be the following:

    a. Mineral-Fiber, Preformed Pipe, Type I: 1 inch thick.

END OF SECTION

THIS PAGE IS INTENTIONALLY LEFT BLANK.

SECTION 22 11 16 - DOMESTIC WATER PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Copper tube and fittings.
2. Ductile-iron pipe and fittings.
3. Piping joining materials.
4. Encasement for piping.

B. Related Requirements:

1. Section 331415 "Site Water Distribution Piping" for water-service piping outside the building from source to the point where water-service piping enters the building.

1.3 ACTION SUBMITTALS

A. Product Data: For transition fittings and dielectric fittings.

B. Sustainable Design Submittals:

1. Product Data: For adhesives, indicating VOC content.
2. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting materials.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Piping layout, or BIM model, drawn to scale, showing the items described in this Section, and coordinated with all building trades.

B. System purging and disinfecting activities report.

C. Field quality-control reports.

1.5 FIELD CONDITIONS

A. Interruption of Existing Water Service: Do not interrupt water service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water service according to requirements indicated:

1. Notify Owner no fewer than seven (7) days in advance of proposed interruption of water service.
2. Do not interrupt water service without Owner's written permission.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

B. Potable-water piping and components shall comply with NSF 14, NSF 61, and NSF 372. Include marking "NSF-pw" on piping.

2.2 COPPER TUBE AND FITTINGS

A. Hard Copper Tube: ASTM B 88, Type L water tube, drawn temper.

B. Soft Copper Tube: ASTM B 88, Type K water tube, annealed temper.

C. Cast-Copper, Solder-Joint Fittings: ASME B16.18, pressure fittings.

D. Wrought-Copper, Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.

E. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.

F. Copper Unions:

1. MSS SP-123.
2. Cast-copper-alloy, hexagonal-stock body.
3. Ball-and-socket, metal-to-metal seating surfaces.
4. Solder-joint or threaded ends.

G. Copper, Brass, or Bronze Pressure-Seal-Joint Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Apollo Valves; Conbraco Industries, Inc.
   b. Elkhart Products Corporation.
   c. Mueller Industries, Inc.

2. Fittings: Cast-brass, cast-bronze or wrought-copper with EPDM O-ring seal in each end. Sizes NPS 2-1/2 and larger with stainless steel grip ring and EPDM O-ring seal.
3. Minimum 200-psig working-pressure rating at 250 deg F.

2.3 DUCTILE-IRON PIPE AND FITTINGS

A. Mechanical-Joint, Ductile-Iron Pipe:

1. AWWA C151/A21.51, with mechanical-joint bell and plain spigot end unless grooved or flanged ends are indicated.
2. Glands, Gaskets, and Bolts: AWWA C111/A21.11, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

B. Standard-Pattern, Mechanical-Joint Fittings:

1. AWWA C110/A21.10, ductile or gray iron.

2. Glands, Gaskets, and Bolts: AWWA C111/A21.11, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

C. Push-on-Joint, Ductile-Iron Pipe:

1. AWWA C151/A21.51.
2. Push-on-joint bell and plain spigot end unless grooved or flanged ends are indicated.

D. Standard-Pattern, Push-on-Joint Fittings:

1. AWWA C110/A21.10, ductile or gray iron.
2. Gaskets: AWWA C111/A21.11, rubber.

E. Plain-End, Ductile-Iron Pipe: AWWA C151/A21.51.

2.4 PIPING JOINING MATERIALS

A. Pipe-Flange Gasket Materials:

1. AWWA C110/A21.10, rubber, flat face, 1/8 inch thick or ASME B16.21, nonmetallic and asbestos free unless otherwise indicated.
2. Full-face or ring type unless otherwise indicated.

B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.

C. Solder Filler Metals: ASTM B 32, lead-free alloys.

D. Flux: ASTM B 813, water flushable.

E. Brazing Filler Metals: AWS A5.8M/A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.

2.5 ENCASEMENT FOR PIPING

A. Standard: ASTM A 674 or AWWA C105/A21.5.

B. Form: Sheet or tube.

C. Color: Black or natural.

2.6 TRANSITION FITTINGS

A. General Requirements:

1. Same size as pipes to be joined.
2. Pressure rating at least equal to pipes to be joined.
3. End connections compatible with pipes to be joined.

B. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.

C. Sleeve-Type Transition Coupling: AWWA C219.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Cascade Waterworks Mfg. Co.

b. Dresser, Inc.
c. Jay R. Smith Mfg Co; a division of Morris Group International.

2.7 DIELECTRIC FITTINGS

A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.

B. Dielectric Unions:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. WATTS.
b. Wilkins.
c. Zurn Industries, LLC.

2. Standard: ASSE 1079.
3. Pressure Rating: 125 psig minimum at 180 deg F.
4. End Connections: Solder-joint copper alloy and threaded ferrous.

C. Dielectric Flanges:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. WATTS.
b. Wilkins.
c. Zurn Industries, LLC.

2. Standard: ASSE 1079.
3. Factory-fabricated, bolted, companion-flange assembly.
4. Pressure Rating: 125 psig minimum at 180 deg F.
5. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

D. Dielectric-Flange Insulating Kits:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Advance Products & Systems, Inc.
b. Calpico, Inc.
c. Pipeline Seal and Insulator, Inc.

2. Nonconducting materials for field assembly of companion flanges.
3. Pressure Rating: 150 psig.
4. Gasket: Neoprene or phenolic.
5. Bolt Sleeves: Phenolic or polyethylene.
6. Washers: Phenolic with steel backing washers.

E. Dielectric Nipples:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Grinnell G-Fire by Johnson Controls Company.
b. Precision Plumbing Products.
c. Sioux Chief Manufacturing Company, Inc.
d. Victaulic Company.

2. Standard: IAPMO PS 66.
3. Electroplated steel nipple complying with ASTM F1545.
4. Pressure Rating and Temperature: 300 psig at 225 deg F.
5. End Connections: Male threaded or grooved.
6. Lining: Inert and noncorrosive, propylene.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.

B. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.

C. Fitting Option: Extruded-tee connections and brazed joints may be used on aboveground copper tubing.

D. Under-building-slab, domestic water, building-service piping, NPS 3 and smaller, shall be the following:

1. Annealed-temper copper tube, ASTM B88, Type L; wrought-copper, solder-joint fittings; and brazed joints.

E. Under-building-slab, domestic water, building-service piping, NPS 4 to NPS 8 and larger, shall be one of the following:

1. Annealed-temper copper tube, ASTM B88, Type L; wrought-copper, solder-joint fittings; and brazed joints.
2. Mechanical-joint, ductile-iron pipe; standard-pattern, mechanical-joint fittings; and mechanical joints.
3. Push-on-joint, ductile-iron pipe; standard-pattern, push-on-joint fittings; and gasketed joints.

F. Under-building-slab, combined domestic water, building-service, and fire-service-main piping, NPS 6 to NPS 12, shall be one of the following:

1. Mechanical-joint, ductile-iron pipe; standard-pattern, mechanical-joint fittings; and mechanical joints.
2. Push-on-joint, ductile-iron pipe; standard-pattern, push-on-joint fittings; and gasketed joints.

G. Under-building-slab, domestic water piping, NPS 2 and smaller, shall be the following:

1. Drawn-temper or annealed-temper copper tube, ASTM B88, Type L; wrought-copper, solder-joint fittings; and brazed joints.

H. Aboveground domestic water piping, NPS 2 and smaller, shall be one of the following:

1. Drawn-temper copper tube, ASTM B88, Type L; wrought-copper, solder-joint fittings; and brazed or soldered joints.
2. Drawn-temper copper tube, ASTM B88, Type L; copper pressure-seal-joint fittings; and pressure-sealed joints.

I. Aboveground domestic water piping, NPS 2-1/2 to NPS 4, shall be one of the following:

1. Drawn-temper copper tube, ASTM B88, Type L; cast- or wrought-copper, solder-joint fittings; and brazed joints.
2. Drawn-temper copper tube, ASTM B88, Type L; copper pressure-seal-joint fittings; and pressure-sealed joints.

J. Aboveground domestic water piping, NPS 5 to NPS 8, shall be one of the following:

1. Drawn-temper copper tube, ASTM B88, Type L; cast- or wrought-copper, solder-joint fittings; and brazed joints.

K. Aboveground, combined domestic water-service and fire-service-main piping, NPS 6 to NPS 12, shall be one of the following:

1. Plain-end, ductile-iron pipe; grooved-joint, ductile-iron-pipe appurtenances; and grooved joints.

3.2 EARTHWORK

A. Comply with requirements in Section 31 20 00 "Earth Moving" for excavating, trenching, and backfilling.

3.3 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.

B. Install copper tubing under building slab according to CDA's "Copper Tube Handbook."

C. Install underground copper tube and ductile iron pipe in PE encasement according to ASTM A 674 or AWWA C105/A21.5.

D. Install ductile-iron piping under building slab with restrained joints according to AWWA C600 and AWWA M41.

E. Install shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve inside the building at each domestic water-service entrance. Comply with requirements for pressure gages in Section 22 05 19 "Meters and Gages for Plumbing Piping" and with requirements for drain valves and strainers in Section 22 11 19 "Domestic Water Piping Specialties."

F. Install valves according to the following:

1. Section 22 05 23.12 "Ball Valves for Plumbing Piping."

2. Section 22 05 23.14 "Check Valves for Plumbing Piping."
3. Section 22 05 23.15 "Gate Valves for Plumbing Piping."

G. Install water-pressure-reducing valves downstream from shutoff valves. Comply with requirements for pressure-reducing valves in Section 22 11 19 "Domestic Water Piping Specialties."

H. Install domestic water piping level without pitch and plumb.

I. Rough-in domestic water piping for water-meter installation according to utility company's requirements.

J. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.

K. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

L. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.

M. Install piping to permit valve servicing.

N. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than the system pressure rating used in applications below unless otherwise indicated.

O. Install piping free of sags and bends.

P. Install fittings for changes in direction and branch connections.

Q. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.

R. Install pressure gages on suction and discharge piping for each plumbing pump and packaged booster pump. Comply with requirements for pressure gages in Section 22 05 19 "Meters and Gages for Plumbing Piping."

S. Install thermostats in hot-water circulation piping. Comply with requirements for thermostats in Section 22 11 23 "Domestic Water Pumps."

T. Install thermometers on inlet and outlet piping from each water heater. Comply with requirements for thermometers in Section 22 05 19 "Meters and Gages for Plumbing Piping."

U. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 22 05 17 "Sleeves and Sleeve Seals for Plumbing Piping."

V. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 22 05 17 "Sleeves and Sleeve Seals for Plumbing Piping."

W. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 22 05 18 "Escutcheons for Plumbing Piping."

3.4 JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.

C. Brazed Joints for Copper Tubing: Comply with CDA's "Copper Tube Handbook," "Brazed Joints" chapter.

D. Soldered Joints for Copper Tubing: Apply ASTM B 813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B 828 or CDA's "Copper Tube Handbook."

E. Pressure-Sealed Joints for Copper Tubing: Join copper tube and pressure-seal fittings with tools and procedure recommended by pressure-seal-fitting manufacturer. Leave insertion marks on pipe after assembly.

F. Push-on Joints for Copper Tubing: Clean end of tube. Measure insertion depth with manufacturer's depth gage. Join copper tube and push-on-joint fittings by inserting tube to measured depth.

G. Flanged Joints: Select appropriate asbestos-free, nonmetallic gasket material in size, type, and thickness suitable for domestic water service. Join flanges with gasket and bolts according to ASME B31.9.

H. Joints for Dissimilar-Material Piping: Make joints using adapters compatible with materials of both piping systems.

3.5 INSTALLATION OF TRANSITION FITTINGS

A. Install transition couplings at joints of dissimilar piping.

B. Transition Fittings in Underground Domestic Water Piping:

1. Fittings for NPS 1-1/2 and Smaller: Fitting-type coupling.
2. Fittings for NPS 2 and Larger: Sleeve-type coupling.

3.6 INSTALLATION OF DIELECTRIC FITTINGS

A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.

B. Dielectric Fittings for NPS 2 and Smaller: Use dielectric unions.

C. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric flanges or flange kits.

D. Dielectric Fittings for NPS 5 and Larger: Use dielectric flange kits.

3.7 INSTALLATION OF HANGERS AND SUPPORTS

A. Comply with requirements for hangers, supports, and anchor devices in Section 22 05 29 "Hangers and Supports for Plumbing Piping and Equipment."

1. Vertical Piping: MSS Type 8 or 42, clamps.
2. Individual, Straight, Horizontal Piping Runs:

a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
c. Longer Than 100 Feet if Indicated: MSS Type 49, spring cushion rolls.

3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
4. Base of Vertical Piping: MSS Type 52, spring hangers.

B. Install hangers for copper tubing and piping, with maximum horizontal spacing and minimum rod diameters, to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

C. Support horizontal piping within 12 inches of each fitting.

D. Support vertical runs of copper tubing and piping to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

3.8 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. When installing piping adjacent to equipment and machines, allow space for service and maintenance.

C. Connect domestic water piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials.

D. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:

1. Domestic Water Booster Pumps: Cold-water suction and discharge piping.
2. Water Heaters: Cold-water inlet and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
3. Plumbing Fixtures: Cold- and hot-water-supply piping in sizes indicated, but not smaller than that required by plumbing code.
4. Equipment: Cold- and hot-water-supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection.

3.9 IDENTIFICATION

A. Identify system components. Comply with requirements for identification materials and installation in Section 22 05 53 "Identification for Plumbing Piping and Equipment."

B. Label pressure piping with system operating pressure.

3.10 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Piping Inspections:

a. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.

b. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:

1) Roughing-in Inspection: Arrange for inspection of piping before concealing or closing in after roughing in and before setting fixtures.
2) Final Inspection: Arrange for authorities having jurisdiction to observe tests specified in "Piping Tests" Subparagraph below and to ensure compliance with requirements.

c. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
d. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

2. Piping Tests:

a. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
b. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.
c. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
d. Cap and subject piping to static water pressure of 1-1/2 times operating pressure or maximum 125 psig, without exceeding pressure rating of piping system materials. Isolate test source and allow it to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
e. Repair leaks and defects with new materials, and retest piping or portion thereof until satisfactory results are obtained.
f. Prepare reports for tests and for corrective action required.

B. Domestic water piping will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.11 ADJUSTING

A. Perform the following adjustments before operation:

1. Close drain valves, hydrants, and hose bibbs.
2. Open shutoff valves to fully open position.
3. Open throttling valves to proper setting.
4. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.

a. Manually adjust ball-type balancing valves in hot-water-circulation return piping to provide hot-water flow in each branch.
b. Adjust calibrated balancing valves to flows indicated.

5. Remove plugs used during testing of piping and for temporary sealing of piping during installation.
6. Remove and clean strainer screens. Close drain valves and replace drain plugs.

7. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.
8. Check plumbing specialties and verify proper settings, adjustments, and operation.

3.12 CLEANING

A. Clean and disinfect potable domestic water piping as follows:

1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:

    a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
    b. Fill and isolate system according to either of the following:

        1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.
        2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours.

    c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
    d. Repeat procedures if biological examination shows contamination.
    e. Submit water samples in sterile bottles to authorities having jurisdiction.

B. Prepare and submit reports of purging and disinfecting activities. Include copies of water-sample approvals from authorities having jurisdiction.

C. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

END OF SECTION

THIS PAGE INTENTIONALLY LEFT BLANK.

SECTION 22 11 19 - DOMESTIC WATER PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Vacuum breakers.
2. Backflow preventers.
3. Water pressure-reducing valves.
4. Balancing valves.
5. Temperature-actuated, water mixing valves.
6. Strainers.
7. Outlet boxes.
8. Hose bibbs.
9. Wall hydrants.
10. Drain valves.
11. Water-hammer arresters.
12. Air vents.
13. Trap seal primer systems
14. Flexible connectors.
15. Water meters.

B. Related Requirements:

1. Section 22 05 19 "Meters and Gauges for Plumbing Piping" for thermometers, pressure gages, and flow meters in domestic water piping.
2. Section 22 11 16 "Domestic Water Piping" for water meters.
3. Section 22 32 00 "Domestic Water Filtration Equipment" for water filters in domestic water piping.
4. Section 22 45 00 "Emergency Plumbing Fixtures" for water tempering equipment.
5. Section 22 47 16 "Pressure Water Coolers" for water filters for water coolers.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For domestic water piping specialties.

1. Include diagrams for power, signal, and control wiring.

C. Sustainable Design Submittals:

1. Product Data: For water consumption.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For domestic water piping specialties to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PIPING SPECIALTIES

A. Potable-water piping and components shall comply with NSF 61.

B. Comply with NSF 372 for low lead.

2.2 PERFORMANCE REQUIREMENTS

A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig unless otherwise indicated.

2.3 VACUUM BREAKERS

A. Pipe-Applied, Atmospheric-Type Vacuum Breakers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Ames Fire & Waterworks; A WATTS Brand.
b. Apollo Flow Controls; Conbraco Industries, Inc.
c. Cash Acme; a division of Reliance Worldwide Corporation.
d. FEBCO; A WATTS Brand.
e. Toro Company (The).
f. WATTS.

2. Standard: ASSE 1001.
3. Size: NPS 1/4 to NPS 4, as required to match connected piping.
4. Body: Bronze.
5. Inlet and Outlet Connections: Threaded.
6. Finish: Chrome plated.

B. Hose-Connection Vacuum Breakers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Apollo Flow Controls; Conbraco Industries, Inc.
b. Cash Acme; a division of Reliance Worldwide Corporation.
c. MIFAB, Inc.
d. WATTS.
e. Woodford Manufacturing Company.

2. Standard: ASSE 1011.
3. Body: Bronze, nonremovable, with manual drain.
4. Outlet Connection: Garden-hose threaded complying with ASME B1.20.7.
5. Finish: Rough bronze.

C. Pressure Vacuum Breakers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Ames Fire & Waterworks; A WATTS Brand.
b. Apollo Flow Controls; Conbraco Industries, Inc.
c. FEBCO; A WATTS Brand.
d. Flomatic Corporation.
e. WATTS.

2. Standard: ASSE 1020.
3. Operation: Continuous-pressure applications.
4. Pressure Loss: 5 psig maximum, through middle third of flow range.
5. Accessories:

a. Valves: Ball type, on inlet and outlet.

2.4 BACKFLOW PREVENTERS

A. Reduced-Pressure-Principle Backflow Preventers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Ames Fire & Waterworks; A WATTS Brand.
b. Apollo Flow Controls; Conbraco Industries, Inc.
c. FEBCO; A WATTS Brand.
d. Flomatic Corporation.
e. WATTS.

2. Standard: ASSE 1013.
3. Operation: Continuous-pressure applications.
4. Pressure Loss: 12 psig maximum, through middle third of flow range.
5. Body: Bronze for NPS 2 and smaller.
6. End Connections: Threaded for NPS 2 and smaller.
7. Configuration: Designed for horizontal, straight-through flow.
8. Accessories:

a. Valves NPS 2 and Smaller: Ball type with threaded ends on inlet and outlet.
b. Air-Gap Fitting: ASME A112.1.2, matching backflow-preventer connection.

B. Double-Check, Backflow-Prevention Assemblies:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Ames Fire & Waterworks; A WATTS Brand.
b. Apollo Flow Controls; Conbraco Industries, Inc.
c. FEBCO; A WATTS Brand.
d. Flomatic Corporation.
e. WATTS.

2. Standard: ASSE 1015.
3. Operation: Continuous-pressure applications unless otherwise indicated.
4. Pressure Loss: 5 psig maximum, through middle third of flow range.

5. Body: Bronze for NPS 2 and smaller; cast iron with interior lining that complies with AWWA C550 or that is FDA approved or stainless steel for NPS 2-1/2 and larger.
6. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
7. Configuration: Designed for horizontal, straight-through flow.
8. Accessories:

    a. Valves NPS 2 and Smaller: Ball type with threaded ends on inlet and outlet.
    b. Valves NPS 2-1/2 and Larger: Outside-screw and yoke-gate type with flanged ends on inlet and outlet.

C. Beverage-Dispensing-Equipment Backflow Preventers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Apollo Flow Controls; Conbraco Industries, Inc.
    b. WATTS.
    c. ZURN Industries.

2. Standard: ASSE 1022.
3. Operation: Continuous-pressure applications.
4. Size: NPS 1/4 or NPS 3/8.
5. Body: Stainless steel.
6. End Connections: Threaded.

D. Dual-Check-Valve Backflow Preventers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Apollo Flow Controls; Conbraco Industries, Inc.
    b. Cash Acme; a division of Reliance Worldwide Corporation.
    c. FEBCO; A WATTS Brand.
    d. Flomatic Corporation.
    e. WATTS.

2. Standard: ASSE 1024.
3. Operation: Continuous-pressure applications.
4. Size: NPS 1/2.
5. Body: Bronze with union inlet.

E. Carbonated-Beverage-Dispenser, Dual-Check-Valve Backflow Preventers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Cash Acme; a division of Reliance Worldwide Corporation.
    b. Lancer Corporation.
    c. WATTS.

2. Standard: ASSE 1032.
3. Operation: Continuous-pressure applications.
4. Size: NPS 1/4 or NPS 3/8.
5. Body: Stainless steel.
6. End Connections: Threaded.

F. Backflow-Preventer Test Kits:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Apollo Flow Controls; Conbraco Industries, Inc.
   b. FEBCO; A WATTS Brand.
   c. Flomatic Corporation.
   d. WATTS.

2. Description: Factory calibrated, with gages, fittings, hoses, and carrying case with test-procedure instructions.

2.5 WATER PRESSURE-REDUCING VALVES

A. Water Regulators:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Apollo Flow Controls; Conbraco Industries, Inc.
   b. Cash Acme; a division of Reliance Worldwide Corporation.
   c. WATTS.

2. Standard: ASSE 1003.
3. Pressure Rating: Initial working pressure of 150 psig.
4. Body: Bronze for NPS 2 and smaller.
5. Valves for Booster Heater Water Supply: Include integral bypass.
6. End Connections: Threaded for NPS 2 and smaller.

B. Water-Control Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Apollo Flow Controls; Conbraco Industries, Inc.
   b. CLA-VAL.
   c. Flomatic Corporation.
   d. WATTS.
   e. Zurn Industries, LLC.

2. Description: Pilot-operated, diaphragm-type, single-seated, main water-control valve.
3. Pressure Rating: Initial working pressure of 150 psig minimum with AWWA C550 or FDA-approved, interior epoxy coating. Include small pilot-control valve, restrictor device, specialty fittings, and sensor piping.
4. Main Valve Body: Cast- or ductile-iron body with AWWA C550 or FDA-approved, interior epoxy coating; or stainless steel body.
5. Pattern: Globe-valve design.
6. Trim: Stainless steel.
7. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
8. Capacities and Characteristics: See Equipment Schedules.

2.6 BALANCING VALVES

A. Copper-Alloy Calibrated Balancing Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Armstrong International, Inc.
b. Flo Fab Inc.
c. ITT Corporation.
d. Schneider Electric USA, Inc.
e. TACO Comfort Solutions, Inc.

2. Type: Ball or Y-pattern globe valve with two readout ports and memory-setting indicator.
3. Body: Bronze; Lead free.
4. Size: Same as connected piping, but not larger than NPS 2.
5. Accessories: Meter hoses, fittings, valves, differential pressure meter, and carrying case.

B. Accessories: Meter hoses, fittings, valves, differential pressure meter, and carrying case.

2.7 TEMPERATURE-ACTUATED, WATER MIXING VALVES

A. Water-Temperature Limiting Devices:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Apollo Flow Controls; Conbraco Industries, Inc.
b. Armstrong International, Inc.
c. Cash Acme; a division of Reliance Worldwide Corporation.
d. Leonard Valve Company.
e. POWERS; A WATTS Brand.
f. Symmons Industries, Inc.
g. WATTS.

2. Standard: ASSE 1017.
3. Pressure Rating: 125 psig.
4. Type: Thermostatically controlled, water mixing valve.
5. Material: Bronze body with corrosion-resistant interior components.
6. Connections: Threaded union inlets and outlet.
7. Accessories: Check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.
8. Valve Finish: Chrome plated.

B. Primary, Thermostatic, Water Mixing Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Acorn Engineering Company.
b. Apollo Flow Controls; Conbraco Industries, Inc.
c. Armstrong International, Inc.
d. Cash Acme; a division of Reliance Worldwide Corporation.
e. Lawler Manufacturing Company, Inc.
f. Leonard Valve Company.
g. POWERS; A WATTS Brand.
h. Symmons Industries, Inc.

2. Standard: ASSE 1017.

3. Pressure Rating: 125 psig minimum unless otherwise indicated.
4. Type: Exposed-mounted, thermostatically controlled, water mixing valve.
5. Material: Bronze body with corrosion-resistant interior components.
6. Connections: Threaded union inlets and outlet.
7. Accessories: Manual temperature control, check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.
8. Valve Finish: Rough bronze.
9. Piping Finish: Copper.

C. Manifold, Thermostatic, Water Mixing-Valve Assemblies:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Lawler Incorporated.
    b. Leonard Valve Company.
    c. POWERS; A WATTS Brand.

2. Description: Factory-fabricated, exposed-mounted, thermostatically controlled, water mixing-valve assembly in three-valve parallel arrangement.
3. Large-Flow Parallel: Thermostatic, water mixing valve and downstream-pressure regulator with pressure gages on inlet and outlet.
4. Intermediate-Flow Parallel: Thermostatic, water mixing valve and downstream-pressure regulator with pressure gages on inlet and outlet.
5. Small-Flow Parallel: Thermostatic, water mixing valve.
6. Thermostatic Mixing Valves: Comply with ASSE 1017. Include check stops on hot- and cold-water inlets and shutoff valve on outlet.
7. Water Regulator(s): Comply with ASSE 1003. Include pressure gage on inlet and outlet.
8. Pressure Rating: 125 psig minimum unless otherwise indicated.
9. Thermostatic Mixing Valve and Water Regulator Finish: Rough bronze.
10. Piping Finish: Copper.

D. Individual-Fixture, Water Tempering Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Apollo Flow Controls; Conbraco Industries, Inc.
    b. Cash Acme; a division of Reliance Worldwide Corporation.
    c. Lawler Manufacturing Company, Inc.
    d. Leonard Valve Company.
    e. POWERS; A WATTS Brand.
    f. WATTS.

2. Standard: ASSE 1016, thermostatically controlled, water tempering valve.
3. Pressure Rating: 125 psig minimum unless otherwise indicated.
4. Body: Bronze body with corrosion-resistant interior components.
5. Temperature Control: Adjustable.
6. Inlets and Outlet: Threaded.
7. Finish: Rough or chrome-plated bronze.

E. Primary Water Tempering Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Heat-Timer Corporation.
    b. Holby Valve Inc.

c. Uponor.

2. Standard: ASSE 1017, thermostatically controlled, water tempering valve, listed as tempering valve.
3. Pressure Rating: 125 psig minimum unless otherwise indicated.
4. Body: Bronze.
5. Temperature Control: Manual.
6. Inlets and Outlet: Threaded.
7. Valve Finish: Rough bronze.

2.8 STRAINERS FOR DOMESTIC WATER PIPING

A. Y-Pattern Strainers:

1. Pressure Rating: 125 psig minimum unless otherwise indicated.
2. Body: Bronze for NPS 2 and smaller; cast iron with interior lining that complies with AWWA C550 or that is FDA approved, epoxy coated and for NPS 2-1/2 and larger.
3. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
4. Screen: Stainless steel with round perforations unless otherwise indicated.
5. Perforation Size:

a. Strainers NPS 2 and Smaller: 0.033 inch.
b. Strainers NPS 2-1/2 to NPS 4: 0.062 inch.

6. Drain: Factory-installed, hose-end drain valve.

2.9 OUTLET BOXES

A. Icemaker Outlet Boxes:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Acorn Engineering Company.
b. IPS Corporation.
c. LSP Products Group, Inc.
d. Oatey.

2. Mounting: Recessed.
3. Material and Finish: Stainless-steel box and faceplate.
4. Faucet: Valved fitting complying with ASME A112.18.1. Include NPS 1/2 or smaller copper tube outlet.
5. Supply Shutoff Fitting: NPS 1/2 ball valve and NPS 1/2 copper, water tubing.

2.10 HOSE BIBBS

A. Hose Bibbs:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Jay R. Smith Mfg. Co.
b. Josam Company.
c. MIFAB, Inc.
d. Tyler Pipe; a subsidiary of McWane Inc.
e. WATTS.
f. Woodford Manufacturing Company.

2. Standard: ASME A112.18.1 for sediment faucets.
3. Body Material: Bronze.
4. Seat: Bronze, replaceable.
5. Supply Connections: NPS 1/2 or NPS 3/4 threaded or solder-joint inlet.
6. Outlet Connection: Garden-hose thread complying with ASME B1.20.7.
7. Pressure Rating: 125 psig.
8. Vacuum Breaker: Integral nonremovable, drainable, hose-connection vacuum breaker complying with ASSE 1011.
9. Finish for Equipment Rooms: Rough bronze, or chrome or nickel plated.
10. Finish for Service Areas: Rough bronze.
11. Finish for Finished Rooms: Chrome or nickel plated.
12. Operation for Equipment Rooms: Wheel handle or operating key.
13. Operation for Service Areas: Wheel handle.
14. Operation for Finished Rooms: Operating key.
15. Include operating key with each operating-key hose bibb.
16. Include wall flange with each chrome- or nickel-plated hose bibb.

2.11 WALL HYDRANTS

A. Nonfreeze Wall Hydrants:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Jay R. Smith Mfg. Co.
    b. Josam Company.
    c. MIFAB, Inc.
    d. Tyler Pipe; a subsidiary of McWane Inc.
    e. WATTS.
    f. Woodford Manufacturing Company.

2. Standard: ASME A112.21.3M for concealed-outlet, self-draining wall hydrants.
3. Pressure Rating: 125 psig.
4. Operation: Loose key.
5. Casing and Operating Rod: Of length required to match wall thickness. Include wall clamp.
6. Inlet: NPS 3/4 or NPS 1.
7. Outlet: Concealed, with integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
8. Box: Deep, flush mounted with cover.
9. Box and Cover Finish: Chrome plated.
10. Outlet: Exposed, with integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
11. Nozzle and Wall-Plate Finish: Polished nickel bronze.
12. Operating Keys(s): One with each wall hydrant.

2.12 DRAIN VALVES

A. Ball-Valve-Type, Hose-End Drain Valves:

1. Standard: MSS SP-110 for standard-port, two-piece ball valves.
2. Pressure Rating: 400-psig minimum CWP.
3. Size: NPS 3/4.
4. Body: Copper alloy.
5. Ball: Chrome-plated brass.
6. Seats and Seals: Replaceable.
7. Handle: Vinyl-covered steel.
8. Inlet: Threaded or solder joint.
9. Outlet: Threaded, short nipple with garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

B. Stop-and-Waste Drain Valves:

1. Standard: MSS SP-110 for ball valves or MSS SP-80 for gate valves.
2. Pressure Rating: 200-psig minimum CWP or Class 125.
3. Size: NPS 3/4.
4. Body: Copper alloy or ASTM B62 bronze.
5. Drain: NPS 1/8 side outlet with cap.

2.13 WATER-HAMMER ARRESTERS

A. Water-Hammer Arresters:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. AMTROL, Inc.
   b. Jay R. Smith Mfg. Co.
   c. Josam Company.
   d. MIFAB, Inc.
   e. Precision Plumbing Products.
   f. Sioux Chief Manufacturing Company, Inc.
   g. Tyler Pipe; a subsidiary of McWane Inc.
   h. WATTS.

2. Standard: ASSE 1010 or PDI-WH 201.
3. Type: Copper tube with piston.
4. Size: ASSE 1010, Sizes AA and A through F, or PDI-WH 201, Sizes A through F.

2.14 AIR VENTS

A. Bolted-Construction Automatic Air Vents:

1. Body: Bronze.
2. Pressure Rating and Temperature: 125-psig minimum pressure rating at 140 deg F.
3. Float: Replaceable, corrosion-resistant metal.
4. Mechanism and Seat: Stainless steel.
5. Size: NPS 1/2 minimum inlet.
6. Inlet and Vent Outlet End Connections: Threaded.

2.15 FLEXIBLE CONNECTORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Flex Pression Ltd.

2. Flex-Hose Co., Inc.
3. Flexicraft Industries.
4. Metraflex Company (The).
5. Sioux Chief Manufacturing Company, Inc.

B. Stainless-Steel-Hose Flexible Connectors: Corrugated-stainless-steel tubing with stainless-steel wire-braid covering and ends welded to inner tubing.

1. Working-Pressure Rating: Minimum 200 psig.
2. End Connections NPS 2 and Smaller: Threaded steel-pipe nipple.

2.16 WATER METERS

A. Compound-Type Water Meters:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. ABB.
b. Badger Industries, Inc.
c. Master Meter, Inc.
d. Mueller Co.
e. Schlumberger Limited.

2. Standard: AWWA C702.
3. Pressure Rating: 150-psig working pressure.
4. Body Design: With integral mainline and bypass meters; totalization meter.
5. Registration: In gallons or cubic feet as required by utility company.
6. Case: Bronze.
7. Pipe Connections: Flanged.

B. Electro-Magnetic Inline Flow Meter:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. ABB.
b. Badger Industries, Inc.
c. Onicon

2. Standard: NSF-61.
3. Pressure Rating: ANSI 150 Class.
4. Accuracy: 0.8% of reading from 1 to 3.3 ft/sec.
5. Memory: Nonvolatile memory; retain all program parameter and totalized values in the event of power loss.
6. Display: Alphanumeric LCD displays total flow, flow rate flow direction and alarm conditions.
7. Output signals: Isolated 4-20 mA analog output.
8. Temperature range: 32°F to 140°F.
9. Flow tube: 304 stainless steel.
10. Communications: Integral RS485.

C. Remote Registration System: Encoder type complying with AWWA C707; modified with signal-transmitting assembly, low-voltage connecting wiring, and remote register assembly as required by utility company.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Backflow Preventers: Install backflow preventers in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction.

1. Locate backflow preventers in same room as connected equipment or system.
2. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe-to-floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are unacceptable for this application.
3. Do not install bypass piping around backflow preventers.

B. Water Regulators: Install with inlet and outlet shutoff valves and bypass with memory-stop balancing valve. Install pressure gages on inlet and outlet.

C. Balancing Valves: Install in locations where they can easily be adjusted.

D. Temperature-Actuated, Water Mixing Valves: Install with check stops or shutoff valves on inlets and with shutoff valve on outlet.

1. Install cabinet-type units recessed in or surface mounted on wall as specified.

E. Y-Pattern Strainers: For water, install on supply side of each control valve, water pressure-reducing valve, solenoid valve and pump.

F. Outlet Boxes: Install boxes recessed in wall or surface mounted on wall. Install 2-by-4-inch fire-retardant-treated-wood blocking, wall reinforcement between studs. Comply with requirements for fire-retardant-treated-wood blocking in Section 06 10 00 "Rough Carpentry."

G. Water-Hammer Arresters: Install in water piping according to PDI-WH 201.

H. Air Vents: Install vents at high points of water piping. Install drain piping and discharge onto floor drain.

I. Trap-Seal Primer Systems: Install with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust system for proper flow.

3.2 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. When installing piping specialties adjacent to equipment and machines, allow space for service and maintenance.

C. Comply with requirements for grounding equipment in Section 26 05 26 "Grounding and Bonding for Electrical Systems."

3.3 IDENTIFICATION

A. Plastic Labels for Equipment: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:

1. Pressure vacuum breakers.
2. Reduced-pressure-principle backflow preventers.
3. Double-check, backflow-prevention assemblies.
4. Carbonated-beverage-machine backflow preventers.
5. Dual-check-valve backflow preventers.
6. Water pressure-reducing valves.
7. Calibrated balancing valves.
8. Primary, thermostatic, water mixing valves.
9. Manifold, thermostatic, water mixing-valve assemblies.
10. Primary water tempering valves.
11. Outlet boxes.
12. Trap-seal primer systems.

B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Section 22 05 53 "Identification for Plumbing Piping and Equipment."

3.4 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Test each reduced-pressure-principle backflow preventer and double-check, backflow-prevention assembly according to authorities having jurisdiction and the device's reference standard.

B. Domestic water piping specialties will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

3.5 ADJUSTING

A. Set field-adjustable pressure set points of water pressure-reducing valves.

B. Set field-adjustable flow set points of balancing valves.

C. Set field-adjustable temperature set points of temperature-actuated, water mixing valves.

END OF SECTION

THIS PAGE IS INTENTIONALLY LEFT BLANK.

SECTION 22 11 23.13 - DOMESTIC-WATER PACKAGED BOOSTER PUMPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Multiplex, variable-speed booster pumps.

B. Related Requirements:

1. Section 221123 "Domestic Water Pumps" for domestic-water circulation pumps.
2. Section 221223 "Facility Indoor Potable-Water Storage Tanks" for separate hydropneumatic domestic-water tanks for multiplex booster pumps.

1.3 DEFINITIONS

A. PID: Proportional Integral Derivative.

B. VFC: Variable-frequency controller.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, and dimensions of individual components and profiles.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: For booster pumps.

1. Include plans, elevations, sections, and mounting details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For booster pumps to include in emergency, operation, and maintenance manuals.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Retain protective coatings and flange's protective covers during storage.

1.8 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Drinking Water System Components - Health Effects and Drinking Water System Components - Lead Content Compliance: NSF 61 and NSF 372.

2.2 MULTIPLEX, VARIABLE-SPEED BOOSTER PUMPS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Armstrong Pumps, Inc.
2. Bell & Gossett; a Xylem brand.
3. Pentair, Aurora Pumps.
4. Tigerflow Systems.

B. Description: Factory-assembled and -tested, fluid-handling system for domestic water, with pumps, piping, valves, specialties, and controls, and mounted on base.

C. Pumps:

1. Type: Vertical, multistage as defined in HI 1.1-1.2 and HI 1.3 for in-line, multistage, separately coupled, overhung-impeller, centrifugal pump.
2. Casing: Cast-iron or steel base and stainless-steel chamber.
3. Impeller: Closed, stainless steel; statically and dynamically balanced and keyed to shaft.
4. Shaft: Stainless steel.
5. Seal: Mechanical.
6. Bearing: Water-lubricated sleeve type.

D. Motors: Single speed, with pre-greased, permanently shielded, ball-bearings. Select motors that will not overload through full range of pump performance curve.

E. Piping: Stainless-steel pipe and fittings.

F. Valves:

1. Shutoff Valves NPS 2 and Smaller: Two-piece, full-port ball valve, in each pump's suction and discharge piping.
2. Shutoff Valves NPS 2-1/2 and Larger: Lug-type butterfly valve, in each pump's suction and discharge piping and in inlet and outlet headers.
3. Check Valves NPS 2 and Smaller: Silent type in each pump's discharge piping.
4. Check Valves NPS 2-1/2 and Larger: Silent type in each pump's discharge piping.
5. Thermal-Relief Valve: Temperature-and-pressure relief type in pump's discharge header piping.

G. Dielectric Fittings: With insulating material to isolate joined dissimilar metals.

H. VFC: Serving each pump in pump array.

1. Manufactured Units: Pulse-width modulated; variable torque for inverter-duty motors.
2. Output Rating: Three phase; 10 to 60 Hz, with voltage proportional to frequency throughout voltage range; maximum voltage equals input voltage.
3. Unit Operating Requirements:

    a. Internal Adjustability:

        1) Minimum Speed: 5 to 25 percent of maximum rpm.
        2) Maximum Speed: 80 to 100 percent of maximum rpm.
        3) Acceleration: 0.1 to 999.9 seconds.
        4) Deceleration: 0.1 to 999.9 seconds.
        5) Current Limit: 30 to minimum of 150 percent of maximum rating.

    b. Self-Protection and Reliability Features:

        1) Surge suppression.
        2) Loss of input signal protection.
        3) Under- and overvoltage trips.
        4) VFC and motor overload/overtemperature protection.
        5) Critical frequency rejection.
        6) Loss-of-phase protection.
        7) Reverse-phase protection.
        8) Motor-overtemperature fault.

    c. Bidirectional autospeed search.
    d. Torque boost.
    e. Motor temperature compensation at slow speeds.

        1) Panel-mounted operator station.
        2) Historical logging information and displays.
        3) Digital indicating devices.

    f. Control Signal Interface: Electric.
    g. Proportional Integral Derivative (PID) control interface.
    h. DDC System for HVAC Protocols for Network Communications: ASHRAE 135.

4. Line Conditioning:

    a. Input line conditioning.
    b. Output filtering.
    c. EMI/RFI filtering.

5. Bypass Systems:

    a. Bypass Mode: Not Required.

6. Instrumentation: Suction and discharge pressure gauges.
7. Lights: Running light for each pump.
8. Alarm Signal Device: Sounds alarm when backup pumps are operating.

    a. Time Delay: Controls alarm operation; adjustable from 1 to 300 seconds, with automatic reset.

9. Thermal-bleed cutoff.
10. Low-suction-pressure cutout.
11. High-suction-pressure cutout.
12. Low-discharge-pressure cutout.
13. High-discharge-pressure cutout.
14. Direct Digital Control (DDC) System for HVAC: Provide auxiliary contacts for interface to BACnet DDC system. DDC systems are specified in Section 230923 "Direct Digital Control (DDC) System for HVAC." Include the following:

    a. On-off status of each pump.
    b. Alarm status.

I. Base: Structural steel.

J. Capacities and Characteristics:

1. See Equipment Schedules.

2.3 MOTORS

A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors.

1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
2. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in NFPA 70.

2.4 SOURCE QUALITY CONTROL

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.

B. ASME Compliance: Comply with ASME B31.9 for piping.

C. UL Compliance for Packaged Pumping Systems:

1. UL 508, "Industrial Control Equipment."
2. UL 508A, "Industrial Control Panels."
3. UL 778, "Motor-Operated Water Pumps."

4. UL 1995, "Heating and Cooling Equipment."

D. Booster pumps shall be listed and labeled as packaged pumping systems by testing agency acceptable to authorities having jurisdiction.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for booster pumps to verify actual locations of piping connections before booster-pump installation.

3.2 INSTALLATION

A. Booster-Pump Mounting:

1. Install booster pumps on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified in Section 033000 "Cast-in-Place Concrete."
2. Comply with requirements for vibration isolation devices specified in Section 220548.13 "Vibration Controls for Plumbing Piping and Equipment."

B. Support connected domestic-water piping so weight of piping is not supported by booster pumps.

3.3 PIPING CONNECTIONS

A. Comply with requirements for piping specified in Section 221116 "Domestic Water Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

B. Booster-Pump Piping Connections: Connect domestic-water piping to booster pumps. Install suction and discharge pipe equal to or greater than size of system suction and discharge headers.

1. Install shutoff valves on piping connections to booster-pump suction and discharge piping. Install ball, butterfly valves same size as suction and discharge piping. Comply with requirements for general-duty valves specified in Section 220523.12 "Ball Valves for Plumbing Piping," Section 220523.13 "Butterfly Valves for Plumbing Piping".
2. Install union, flanged, or grooved-joint connections on suction and discharge piping at connection to domestic-water piping. Comply with requirements for unions and flanges specified in Section 221116 "Domestic Water Piping."
3. Install valved bypass, same size as and between piping, at connections to booster-pump suction and discharge headers. Comply with requirements for domestic-water piping specified in Section 221116 "Domestic Water Piping."
4. Install flexible connectors, same size as piping, on piping connections to booster-pump suction and discharge headers. Comply with requirements for flexible connectors specified in Section 221116 "Domestic Water Piping."
5. Where installing piping adjacent to booster pumps, allow space for service and maintenance.

3.4 ELECTRICAL CONNECTIONS

A. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

B. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

C. Install electrical devices furnished by manufacturer, but not factory mounted, according to NFPA 70 and NECA 1.

3.5 CONTROL CONNECTIONS

A. Install control and electrical power wiring to field-mounted control devices.

B. Connect control wiring according to Section 260523 "Control-Voltage Electrical Power Cables."

3.6 IDENTIFICATION

A. Identify system components. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

B. Install nameplate for each electrical connection, indicating electrical equipment designation and circuit number feeding connection.

1. Nameplate shall be laminated acrylic or melamine plastic signs, as specified in Section 260553 "Identification for Electrical Systems."
2. Nameplate shall be laminated acrylic or melamine plastic signs with a black background and engraved white letters at least 1/2 inch high.

3.7 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

B. Perform tests and inspections with the assistance of a factory-authorized service representative.

1. Perform visual and mechanical inspection.
2. Leak Test: After installation, charge booster pump and test for leaks. Repair leaks and retest until no leaks exist.
3. Operational Test: After electrical circuitry has been energized, start booster pumps to confirm proper motor rotation and booster-pump operation.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Pumps and controls will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

3.8 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.

3.9 ADJUSTING

A. Adjust booster pumps to function smoothly, and lubricate as recommended by manufacturer.

B. Adjust pressure set points.

C. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting booster pump to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

3.10 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain booster pumps.

END OF SECTION

THIS PAGE IS INTENTIONALLY LEFT BLANK.

SECTION 22 11 23.21 - INLINE, DOMESTIC-WATER PUMPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. In-line, sealless centrifugal pumps.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product. Include construction materials, rated capacities, certified performance curves with operating points plotted on curves, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Sustainable Design Submittals:

1. Product Data: For pump controls.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Detail pumps and adjacent equipment. Show support locations, type of support, weight on each support, required clearances, and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Structural members to which pumps will be attached.
2. Size and location of initial access modules for acoustical tile.

B. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For inline, domestic-water pumps to include in operation and maintenance manuals.

1.6 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. UL Compliance: Comply with UL 778 for motor-operated water pumps.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Retain shipping flange protective covers and protective coatings during storage.

B. Protect bearings and couplings against damage.

C. Comply with pump manufacturer's written instructions for handling.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. UL Compliance: UL 778 for motor-operated water pumps.

C. Drinking Water System Components - Health Effects and Drinking Water System Components - Lead Content Compliance: NSF 61 and NSF 372.

2.2 IN-LINE, SEALLESS CENTRIFUGAL PUMPS

A. Description: Factory-assembled and -tested, in-line, close-coupled, canned-motor, sealless, overhung-impeller centrifugal pumps.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Bell & Gossett Domestic Pump, ITT Corporation.
2. Flo Fab Inc.
3. Grundfos Pumps Corp.
4. TACO Comfort Solutions, Inc.

C. Capacities and Characteristics:

1. See Equipment Schedules for capacity and characteristics.

D. Pump Construction:

1. Pump and Motor Assembly: Hermetically sealed, replaceable-cartridge type with motor and impeller on common shaft and designed for installation with pump and motor shaft horizontal.
2. Minimum Working Pressure: 125 psig.
3. Maximum Continuous Operating Temperature: 220 deg F.
4. Casing: Bronze, with threaded or companion-flange connections.
5. Impeller: Stainless steel.
6. Motor: Single speed.
7. Lead-free: In compliance with the State of Maryland requirements.

2.3 MOTORS

A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 22 05 13 "Common Motor Requirements for Plumbing Equipment."

1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.

2.4 CONTROLS

A. Thermostats: Electric; adjustable for control of hot-water circulation pump.

1. Type: Water-immersion temperature sensor, for installation in piping.
2. Range: 65 to 200 deg F.
3. Enclosure: NEMA 250, Type 12 or 4X.
4. Operation of Pump: On or off.
5. Transformer: Provide if required.
6. Power Requirement: 120 V ac.
7. Settings: Start pump at 110 deg F and stop pump at 120 deg F.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for domestic-water-piping system to verify actual locations of piping connections before pump installation.

3.2 PUMP INSTALLATION

A. Comply with HI 1.4.

B. Mount pumps in orientation complying with manufacturer's written instructions.

C. Pump Mounting:

1. Install vertically mounted, in-line, close-coupled centrifugal pumps with cast-iron base mounted on concrete base using vibration isolation type and deflection as specified in Section 22 05 48.13 "Vibration Controls for Plumbing Piping and Equipment."
2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
3. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
4. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
5. Install anchor bolts to elevations required for proper attachment to supported equipment.

D. Install continuous-thread hanger rods and vibration isolation of size required to support pump weight.

1. Comply with requirements for vibration isolation devices specified in Section 22 05 48.13 "Vibration Controls for Plumbing Piping and Equipment." Fabricate brackets or supports as required.
2. Comply with requirements for hangers and supports specified in Section 22 05 29 "Hangers and Supports for Plumbing Piping and Equipment."

3.3 PIPING CONNECTIONS

A. Comply with requirements for piping specified in Section 22 11 16 "Domestic Water Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

B. Where installing piping adjacent to inline, domestic-water pumps, allow space for service and maintenance.

C. Connect domestic-water piping to pumps. Install suction and discharge piping equal to or greater than size of pump nozzles.

1. Install flexible connectors adjacent to pumps in suction and discharge piping of the following pumps:

a. Horizontally mounted, in-line, separately coupled centrifugal pumps.
b. Comply with requirements for flexible connectors specified in Section 22 11 16 "Domestic Water Piping."

D. Install shutoff valve and strainer on suction side of each pump, and check, shutoff, and throttling valves on discharge side of each pump. Install valves same size as connected piping. Comply with requirements for strainers specified in Section 22 11 19 "Domestic Water Piping Specialties." Comply with requirements for valves specified in the following:

1. Section 22 05 23.12 "Ball Valves for Plumbing Piping."
2. Section 22 05 23.14 "Check Valves for Plumbing Piping."
3. Install pressure gauge and snubber at suction of each pump and pressure gauge and snubber at discharge of each pump. Install at integral pressure-gauge tappings where provided or install pressure-gauge connectors in suction and discharge piping around pumps. Comply with requirements for pressure gauges and snubbers specified in Section 22 05 19 "Meters and Gages for Plumbing Piping."

3.4 CONTROL CONNECTIONS

A. Install control and electrical power wiring to field-mounted control devices.

B. Connect control wiring between temperature controllers and devices.

3.5 IDENTIFICATION

A. Identify system components. Comply with requirements for identification specified in Section 22 05 53 "Identification for Plumbing Piping and Equipment" for identification of pumps.

3.6 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

B. Perform tests and inspections with the assistance of a factory-authorized service representative.

C. Tests and Inspections:

1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Inline, domestic-water pump will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

3.7 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.
2. Check piping connections for tightness.
3. Clean strainers on suction piping.
4. Set thermostats for automatic starting and stopping operation of pumps.
5. Perform the following startup checks for each pump before starting:

    a. Verify bearing lubrication.
    b. Verify that pump is free to rotate by hand and that pump for handling hot liquid is free to rotate with pump hot and cold. If pump is bound or drags, do not operate until cause of trouble is determined and corrected.
    c. Verify that pump is rotating in the correct direction.

6. Prime pump by opening suction valves and closing drains, and prepare pump for operation.
7. Start motor.
8. Open discharge valve slowly.
9. Adjust temperature settings on thermostats.
10. Adjust timer settings.

3.8 ADJUSTING

A. Adjust inline, domestic-water pumps to function smoothly, and lubricate as recommended by manufacturer.

B. Adjust initial temperature set points.

C. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

END OF SECTION

THIS PAGE INTENTIONALLY LEFT BLANK.

SECTION 22 12 23.11 - FACILITY INDOOR POTABLE-WATER STORAGE TANKS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Insulated, steel, potable-water storage tanks.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for water storage tanks.
2. Include rated capacities, operating characteristics, and furnished specialties and accessories.

1.4 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of potable-water storage tank, from manufacturer.

B. Source quality-control reports.

C. Purging and disinfecting reports.

1.5 QUALITY ASSURANCE

A. ASME Compliance for Steel Tanks: Fabricate and label steel, ASME-code, potable-water storage tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, "Pressure Vessels," Division 1.

B. Comply with NSF 61 Annex G, "Drinking Water System Components - Health Effects," for potable-water storage tanks. Include appropriate NSF marking.

1.6 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided.

PART 2 - PRODUCTS

2.1 STEEL, PRECHARGED, POTABLE-WATER STORAGE TANKS

A. Steel, Precharged, Bladder, Water Storage Tanks:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Armstrong Fluid Technology.
b. Flo Fab Inc.
c. Taco Comfort Solutions.
d. Wessels Company.
e. Wood, John Co.

2. Description: Steel, vertical, pressured-rated tank with cylindrical sidewalls and with air-charging valve and air precharge.
3. Fabricate supports and attachments to tank with reinforcement strong enough to resist tank movement during seismic event when tank supports are anchored to building structure.
4. Operation: Factory-installed, butyl-rubber bladder.

B. Construction: ASME code, steel, constructed with nontoxic welded joints, for 125-psig working pressure.

C. Tappings: Factory-fabricated stainless steel, welded to tank.

1. NPS 2 and Smaller: ASME B1.20.1, with female thread.
2. NPS 2-1/2 and Larger: ASME B16.5, flanged.

D. Specialties and Accessories: Include tappings in tank and the following:

1. Pressure gage.

E. Vertical Tank Supports: Factory-fabricated steel legs or steel skirt, welded to tank.

F. Tank Interior Finish: Materials and thicknesses complying with NSF 61 Annex G barrier materials for potable-water tank linings. Extend finish into and through tank fittings and outlets.

1. Lining Material: Cement or Copper.
2. Coating: Epoxy resin.

G. Exterior Coating: Manufacturer's standard enamel paint.

2.2 SOURCE QUALITY CONTROL

A. Test and inspect potable-water storage tanks according to the following tests and inspections and prepare test reports:

1. Pressure Testing for ASME-Code, Potable-Water Storage Tanks: Hydrostatically test to ensure structural integrity and freedom from leaks. Fill tanks with water, vent air, pressurize to 1-1/2 times tank pressure rating, disconnect test equipment, hold pressure for 30 minutes with no drop in pressure, and check for leaks.

B. Repair or replace tanks that fail test with new tanks, and repeat until test is satisfactory.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install water storage tanks on concrete bases, level and plumb, firmly anchored. Arrange so devices needing servicing are accessible.

B. Anchor tank supports and tanks to substrate.

C. Install thermometers and pressure gages on water storage tanks and piping if indicated. Thermometers and pressure gages are specified in Section 220519 "Meters and Gages for Plumbing Piping."

D. Install the following devices on tanks:

1. Pressure relief valves.
2. Connections to accessories.

E. After installing tanks with factory finish, inspect finishes and repair damages to finishes.

3.2 CONNECTIONS

A. Piping installation requirements are specified in Section 221116 "Domestic Water Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to potable-water storage tanks to allow service and maintenance.

C. Connect water piping to water storage tanks with unions or flanges and with shutoff valves. Connect tank drains with shutoff valves and discharge over closest floor drains.

1. General-duty valves are specified in Section 220523.12 "Ball Valves for Plumbing Piping, and " Section 220523.13 "Butterfly Valves for Plumbing Piping."

    a. Valves NPS 2 and Smaller: Ball.
    b. Valves NPS 2-1/2 and Larger: Butterfly.
    c. Drain Valves: NPS 3/4 ball valve. Include outlet with, or nipple in outlet with, ASME B1.20.7, 3/4-11.5NH thread for garden-hose service, threaded cap, and chain.

2. Water Piping Connections: Make connections to dissimilar metals with dielectric fittings. Dielectric fittings are specified in Section 221116 "Domestic Water Piping."

3.3 IDENTIFICATION

A. Identify system components. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.4 FIELD QUALITY CONTROL

A. Perform the following final checks before filling:

1. Verify that air precharge in precharged tanks is correct.
2. Test operation of tank accessories and devices.
3. Verify that pressure relief valves have correct setting.

    a. Manually operate pressure relief valves.
    b. Adjust pressure settings.

4. Verify that vacuum relief valves are correct size.
    a. Manually operate vacuum relief valves.
    b. Adjust vacuum settings.

B. Filling Procedures: Follow manufacturer's written procedures. Fill tanks with water to operating level.

3.5 CLEANING

A. Clean and disinfect potable-water storage tanks.

B. Use purging and disinfecting procedure prescribed by authorities having jurisdiction or, if method is not prescribed, use procedure described in AWWA C652 or as described below:

1. Purge water storage tanks with potable water.
2. Disinfect tanks by one of the following methods:

    a. Fill tanks with water-chlorine solution containing at least 50 ppm of chlorine. Isolate tanks and allow to stand for 24 hours.
    b. Fill tanks with water-chlorine solution containing at least 200 ppm of chlorine. Isolate tanks and allow to stand for three hours.

3. Flush tanks, after required standing time, with clean, potable water until chlorine is not present in water coming from tank.
4. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedure if biological examination made by authorities having jurisdiction shows evidence of contamination.

C. Prepare written reports for purging and disinfecting activities.

END OF SECTION

SECTION 22 13 13 - FACILITY SANITARY SEWERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. PVC pipe and fittings.
2. Nonpressure-type transition couplings.
3. Pressure-type pipe couplings.
4. Cleanouts.
5. Concrete.

1.3 ACTION SUBMITTALS

A. Product Data: For the following:

1. Pipe and fittings.
2. Non-pressure and pressure couplings
3. Cleanouts.

B. Shop Drawings: For manholes. Include plans, elevations, sections, details, and frames and covers.

1.4 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of pipe and fitting.

B. Field quality-control reports.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Do not store plastic manholes, pipe, and fittings in direct sunlight.

B. Protect pipe, pipe fittings, and seals from dirt and damage.

C. Handle manholes according to manufacturer's written rigging instructions.

1.6 FIELD CONDITIONS

A. Interruption of Existing Sanitary Sewerage Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:

1. Notify Architect no fewer than seven days in advance of proposed interruption of service.
2. Do not proceed with interruption of service without Architect's written permission.

PART 2 - PRODUCTS

2.1 PVC PIPE AND FITTINGS

A. PVC Type PSM Sewer Piping:

1. Pipe: ASTM D3034, SDR 35, PVC Type PSM sewer pipe with bell-and-spigot ends for gasketed joints.
2. Fittings: ASTM D3034, PVC with bell ends.
3. Gaskets: ASTM F477, elastomeric seals.

B. PVC Pressure Piping:

1. Pipe: ASTM D2241, SDR-21; or ASTM D1785, Schedule 40 for working pressure of 200 psi, PVC pipe with bell and spigot ends for gasketed joints.
2. Fittings: Minimum pressure of 200 psi.
3. Gaskets: ASTM F477, elastomeric seals.

2.2 NONPRESSURE-TYPE TRANSITION COUPLINGS

A. Comply with ASTM C1173, elastomeric, sleeve-type, reducing or transition coupling; for joining underground nonpressure piping. Include ends of same sizes as piping to be joined and include corrosion-resistant-metal tension band and tightening mechanism on each end.

B. Sleeve Materials:

1. For Cast-Iron Soil Pipes: ASTM C564, rubber.
2. For Concrete Pipes: ASTM C443, rubber.
3. For Fiberglass Pipes: ASTM F477, elastomeric seal or ASTM D5926, PVC.
4. For Plastic Pipes: ASTM F477, elastomeric seal or ASTM D5926, PVC.
5. For Dissimilar Pipes: ASTM D5926, PVC or other material compatible with pipe materials being joined.

C. Unshielded, Flexible Couplings:

1. Description: Elastomeric sleeve with stainless-steel shear ring and corrosion-resistant-metal tension band and tightening mechanism on each end.

D. Shielded, Flexible Couplings:

1. Description: ASTM C1460, elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.

E. Ring-Type, Flexible Couplings:

1. Description: Elastomeric compression seal with dimensions to fit inside bell of larger pipe and for spigot of smaller pipe to fit inside ring.

F. Nonpressure-Type, Rigid Couplings:

1. Description: ASTM C1461, sleeve-type, reducing- or transition-type mechanical coupling; molded from ASTM C1440, TPE material; with corrosion-resistant-metal tension band and tightening mechanism on each end.

2.3 PRESSURE-TYPE PIPE COUPLINGS

A. Tubular-Sleeve Couplings: AWWA C219, with center sleeve, gaskets, end rings, and bolt fasteners.

B. Metal, bolted, sleeve-type, reducing or transition coupling; for joining underground pressure piping. Include 150-psig minimum pressure rating and ends of same sizes as piping to be joined.

C. Center-Sleeve Material: Manufacturer's standard.

D. Gasket Material: Natural or synthetic rubber.

E. Metal Component Finish: Corrosion-resistant coating or material.

2.4 CLEANOUTS

A. Cast-Iron Cleanouts:

1. Description: ASME A112.36.2M, round, gray-iron housing with clamping device and round, secured, scoriated, gray-iron cover. Include gray-iron ferrule with inside calk or spigot connection and countersunk, tapered-thread, brass closure plug.

2. Top-Loading Classification(s): Heavy Duty.
3. Sewer Pipe Fitting and Riser to Cleanout: ASTM A74, Service class, cast-iron soil pipe and fittings.

B. PVC Cleanouts:

1. Description: PVC body with PVC threaded plug. Include PVC sewer pipe fitting and riser to cleanout of same material as sewer piping.

2.5 CONCRETE

A. General: Cast-in-place concrete complying with ACI 318, ACI 350, and the following:

1. Cement: ASTM C150/C150M, Type II.
2. Fine Aggregate: ASTM C33/C33M, sand.
3. Coarse Aggregate: ASTM C33/C33M, crushed gravel.
4. Water: Potable.

B. Portland Cement Design Mix: 4000 psi minimum, with 0.45 maximum water/cementitious materials ratio.

1. Reinforcing Fabric: ASTM A1064/A1064M, steel, welded wire fabric, plain.
2. Reinforcing Bars: ASTM A615/A615M, Grade 60 deformed steel.

C. Ballast and Pipe Supports: Portland cement design mix, 3000 psi minimum, with 0.58 maximum water/cementitious materials ratio.

1. Reinforcing Fabric: ASTM A1064/A1064M, steel, welded wire fabric, plain.
2. Reinforcing Bars: ASTM A615/A615M, Grade 60 deformed steel.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Excavating, trenching, and backfilling are specified in Section 312000 "Earth Moving."

3.2 PIPING INSTALLATION

A. General Locations and Arrangements: Drawing plans and details to indicate general location and arrangement of underground sanitary sewer piping. Location and arrangement of piping layout take into account design considerations. Install piping as indicated, to extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.

B. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for using lubricants, cements, and other installation requirements.

C. Install manholes for changes in direction unless fittings are indicated. Use fittings for branch connections unless direct tap into existing sewer is indicated.

D. Install proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.

E. Install gravity-flow, nonpressure, drainage piping according to the following:

1. Install piping pitched down in direction of flow, at minimum slope of 2 percent unless otherwise indicated.
2. Install piping with 36-inch minimum cover.
3. Install PVC gravity sewer piping according to ASTM D2321 and ASTM F1668.

F. Install force-main, pressure piping according to the following:

1. Install piping with restrained joints at tee fittings and at horizontal and vertical changes in direction. Use corrosion-resistant rods, pipe or fitting manufacturer's proprietary restraint system, or cast-in-place-concrete supports or anchors.
2. Install piping with 36-inch minimum cover.
3. Install PVC pressure piping according to AWWA M23 or to ASTM D2774 and ASTM F1668.

G. Clear interior of piping and manholes of dirt and superfluous material as work progresses. Maintain swab or drag in piping, and pull past each joint as it is completed. Place plug in end of incomplete piping at end of day and when work stops.

3.3 PIPE JOINT CONSTRUCTION

A. Join gravity-flow, nonpressure, drainage piping according to the following:

1. Join PVC gravity sewer piping according to ASTM D2321 and ASTM D3034 for elastomeric-seal joints or ASTM D3034 for elastomeric-gasket joints.
2. Join dissimilar pipe materials with nonpressure-type, flexible or rigid couplings.

B. Join force-main, pressure piping according to the following:

1. Join PVC pressure piping according to AWWA M23 for gasketed joints.
2. Join dissimilar pipe materials with pressure-type couplings.

C. Pipe couplings, expansion joints, and deflection fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.

1. Use nonpressure flexible couplings where required to join gravity-flow, nonpressure sewer piping unless otherwise indicated.

    a. Unshielded flexible or rigid couplings for pipes of same or slightly different OD.
    b. Unshielded, increaser/reducer-pattern, flexible or rigid couplings for pipes with different OD.
    c. Ring-type flexible couplings for piping of different sizes where annular space between smaller piping's OD and larger piping's ID permits installation.

2. Use pressure pipe couplings for force-main joints.

3.4 CONCRETE PLACEMENT

A. Place cast-in-place concrete according to ACI 318.

3.5 CLEANOUT INSTALLATION

A. Install cleanouts and riser extensions from sewer pipes to cleanouts at grade. Use cast-iron soil pipe fittings in sewer pipes at branches for cleanouts, and use cast-iron soil pipe for riser extensions to cleanouts. Install piping so cleanouts open in direction of flow in sewer pipe.

1. Use Heavy-Duty, top-loading classification cleanouts in vehicle-traffic service areas.

B. Set cleanout frames and covers in earth in cast-in-place-concrete block, 18 by 18 by 12 inches deep. Set with tops 1 inch above surrounding grade.

C. Set cleanout frames and covers in concrete pavement and roads with tops flush with pavement surface.

3.6 CONNECTIONS

A. Connect nonpressure, gravity-flow drainage piping to building's sanitary building drains specified in Section 221316 "Sanitary Waste and Vent Piping."

B. Connect force-main piping to building's sanitary force mains specified in Section 221316 "Sanitary Waste and Vent Piping." Terminate piping where indicated.

C. Make connections to existing piping and underground manholes.

1. Use commercially manufactured wye fittings for piping branch connections. Remove section of existing pipe, install wye fitting into existing piping, and encase entire wye fitting plus 6-inch overlap with not less than 6 inches of concrete with 28-day compressive strength of 3000 psi.
2. Make branch connections from side into existing piping, NPS 4 to NPS 20. Remove section of existing pipe, install wye fitting into existing piping, and encase entire wye with not less than 6 inches of concrete with 28-day compressive strength of 3000 psi.
3. Make branch connections from side into existing piping, NPS 21 or larger, or to underground manholes by cutting opening into existing unit large enough to allow 3 inches of concrete to be packed around entering connection. Cut end of connection pipe passing through pipe or structure wall to conform to shape of, and be flush with, inside wall unless otherwise indicated. On outside of pipe or manhole wall, encase entering connection in 6 inches of concrete for minimum length of 12 inches to provide additional support of collar from connection to undisturbed ground.

    a. Use concrete that will attain a minimum 28-day compressive strength of 3000 psi unless otherwise indicated.
    b. Use epoxy-bonding compound as interface between new and existing concrete and piping materials.

4. Protect existing piping and manholes to prevent concrete or debris from entering while making tap connections. Remove debris or other extraneous material that may accumulate.

3.7 IDENTIFICATION

A. Comply with requirements in Section 312000 "Earth Moving" for underground utility identification devices. Arrange for installation of green warning tapes directly over piping and at outside edges of underground manholes.

1. Use detectable warning tape over ferrous piping.
2. Use detectable warning tape over nonferrous piping and over edges of underground manholes.

3.8 FIELD QUALITY CONTROL

A. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches of backfill is in place, and again at completion of Project.

1. Submit separate report for each system inspection.
2. Defects requiring correction include the following:

    a. Alignment: Less than full diameter of inside of pipe is visible between structures.

b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.
c. Damage: Crushed, broken, cracked, or otherwise damaged piping.
d. Infiltration: Water leakage into piping.
e. Exfiltration: Water leakage from or around piping.

3. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
4. Reinspect and repeat procedure until results are satisfactory.

B. Test new piping systems, and parts of existing systems that have been altered, extended, or repaired, for leaks and defects.

1. Do not enclose, cover, or put into service before inspection and approval.
2. Test completed piping systems according to requirements of authorities having jurisdiction.
3. Schedule tests and inspections by authorities having jurisdiction with at least 24 hours' advance notice.
4. Submit separate report for each test.
5. Hydrostatic Tests: Test sanitary sewerage according to requirements of authorities having jurisdiction and the following:

a. Fill sewer piping with water. Test with pressure of at least 10-foot head of water, and maintain such pressure without leakage for at least 15 minutes.
b. Close openings in system and fill with water.
c. Purge air and refill with water.
d. Disconnect water supply.
e. Test and inspect joints for leaks.

6. Air Tests: Test sanitary sewerage according to requirements of authorities having jurisdiction, UNI-B-6, and the following:

a. Test plastic gravity sewer piping according to ASTM F1417.

7. Force Main: Perform hydrostatic test after thrust blocks, supports, and anchors have hardened. Test at pressure not less than 1-1/2 times the maximum system operating pressure, but not less than 150 psig.

a. PVC Piping: Test according to AWWA M23, "Testing and Maintenance" Chapter.

C. Leaks and loss in test pressure constitute defects that must be repaired.

D. Replace leaking piping using new materials, and repeat testing until leakage is within allowances specified.

3.9 CLEANING

A. Clean dirt and superfluous material from interior of piping. Flush with potable water.

END OF SECTION

This page is intentionally left blank.

SECTION 22 13 16 - SANITARY WASTE AND VENT PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Hub-and-spigot, cast-iron soil pipe and fittings.
2. Hubless, cast-iron soil pipe and fittings.
3. Galvanized-steel pipe and fittings.
4. Copper tube and fittings.
5. PVC pipe and fittings.
6. Specialty pipe fittings.
7. Encasement for underground metal piping.

B. Related Requirements:

1. Section 22 13 13 "Facility Sanitary Sewers" for sanitary sewerage piping and structures outside the building.
2. Section 22 13 29 "Sanitary Sewerage Pumps" for effluent and sewage pumps.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:

1. Product Data: For adhesives, indicating VOC content.
2. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting materials.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.5 FIELD CONDITIONS

A. Interruption of Existing Sanitary Waste Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:

1. Notify Owner no fewer than seven (7) days in advance of proposed interruption of sanitary waste service.
2. Do not proceed with interruption of sanitary waste service without Owner's written permission.

B. Field quality-control reports.

1.6 WARRANTY

A. Listed manufacturers to provide labeling and warranty of their respective products.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Components and installation shall be capable of withstanding the following minimum working pressure unless otherwise indicated:

1. Soil, Waste, and Vent Piping: 10-foot head of water.
2. Waste, Force-Main Piping: 50 psig.

2.2 PIPING MATERIALS

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

B. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.3 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. AB & I Foundry; a part of the McWane family of companies.
2. Charlotte Pipe and Foundry Company.
3. Tyler Pipe Company.

B. Pipe and Fittings: ASTM A 74, Service and Extra Heavy class(es).

C. Gaskets: ASTM C 564, rubber.

2.4 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. AB & I Foundry; a part of the McWane family of companies.
2. Charlotte Pipe and Foundry Company.
3. Tyler Pipe Company.

B. Pipe and Fittings:

1. Marked with CISPI collective trademark.
2. ASTM A 888 or CISPI 301.

C. CISPI, Hubless-Piping Couplings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. ANACO-Husky.
b. Charlotte Pipe and Foundry Company.
c. Fernco Inc.

d. MIFAB, Inc.
e. Tyler Pipe Company.

2. Standards: ASTM C 1277 and CISPI 310.
3. Description: Stainless-steel corrugated shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

D. Heavy-Duty, Hubless-Piping Couplings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. ANACO-Husky.
b. Charlotte Pipe and Foundry Company.
c. MIFAB, Inc.
d. Tyler Pipe Company.

2. Standards: ASTM C 1277 and ASTM C 1540.
3. Description: Stainless-steel shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

2.5 GALVANIZED-STEEL PIPE AND FITTINGS

A. Galvanized-Steel Pipe: ASTM A53/A53M, Type E, standard-weight cast iron. Include square-cut-grooved or threaded ends matching joining method.

B. Steel Pipe Pressure Fittings:

1. Galvanized-Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M or ASTM A 106/A 106M, Schedule 40, seamless steel pipe. Include ends matching joining method.
2. Malleable-Iron Unions: ASME B16.39; Class 150; hexagonal-stock body with ball-and-socket, metal-to-metal, bronze seating surface; and female threaded ends.
3. Galvanized-Gray-Iron, Threaded Fittings: ASME B16.4, Class 125, standard pattern.

2.6 COPPER TUBE AND FITTINGS

A. Copper Type DWV Tube: ASTM B 306, drainage tube, drawn temper.

B. Copper Drainage Fittings: ASME B16.23, cast copper or ASME B16.29, wrought copper, solder-joint fittings.

C. Hard Copper Tube: ASTM B 88, Type L and Type M, water tube, drawn temper.

D. Soft Copper Tube: ASTM B 88, Type L, water tube, annealed temper.

E. Copper Pressure Fittings:

1. Copper Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.
2. Copper Unions: MSS SP-123, copper-alloy, hexagonal-stock body with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.

F. Solder: ASTM B 32, lead free with ASTM B 813, water-flushable flux.

2.7 PVC PIPE AND FITTINGS

A. Comply with NSF 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-DWV" for plastic drain, below grade waste piping.

B. Solid-Wall PVC Pipe: ASTM D 2665, drain, waste, and vent.

C. Adhesive Primer: ASTM F 656.

D. Solvent Cement: ASTM D 2564.

2.8 SPECIALTY PIPE FITTINGS

A. Transition Couplings:

1. General Requirements: Fitting or device for joining piping with small differences in ODs or of different materials. Include end connections of same size as and compatible with pipes to be joined.
2. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
3. Shielded, Nonpressure Transition Couplings:

    a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

        1) Cascade Waterworks Mfg. Co.
        2) Mission Rubber Company, LLC; a division of MCP Industries.

    b. Standard: ASTM C 1460.
    c. Description: Elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.
    d. End Connections: Same size as and compatible with pipes to be joined.

B. Dielectric Fittings:

1. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.
2. Dielectric Unions:

    a. Description:

        1) Standard: ASSE 1079.
        2) Pressure Rating: 125 psig minimum at 180 deg F.
        3) End Connections: Solder-joint copper alloy and threaded ferrous.

3. Dielectric Nipples:

    a. Description:

        1) Standard: IAPMO PS 66.
        2) Electroplated steel nipple.
        3) Pressure Rating: 300 psig at 225 deg F.
        4) End Connections: Male threaded.

5) Lining: Inert and noncorrosive, propylene.

2.9 ENCASEMENT FOR UNDERGROUND METAL PIPING

A. Standard: ASTM A 674 or AWWA C105/A 21.5.

B. Material: Linear low-density polyethylene film of 0.008-inch or high-density, cross-laminated polyethylene film of 0.004-inch minimum thickness.

C. Form: Sheet or tube.

D. Color: Black or natural.

PART 3 - EXECUTION

3.1 EARTH MOVING

A. Comply with requirements for excavating, trenching, and backfilling specified in Section 31 20 00 "Earth Moving."

3.2 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems.

1. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations.
2. Install piping as indicated unless deviations to layout are approved on coordination drawings.

B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

E. Install piping to permit valve servicing.

F. Install piping at indicated slopes.

G. Install piping free of sags and bends.

H. Install fittings for changes in direction and branch connections.

I. Install piping to allow application of insulation.

J. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends.

1. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical.

2. Use long-turn, double Y-branch and 1/8-bend fittings if two fixtures are installed back to back or side by side with common drain pipe.

    a. Straight tees, elbows, and crosses may be used on vent lines.

3. Do not change direction of flow more than 90 degrees.
4. Use proper size of standard increasers and reducers if pipes of different sizes are connected.
    a. Reducing size of waste piping in direction of flow is prohibited.

K. Lay buried building waste piping beginning at low point of each system.
1. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream.
2. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements.
3. Maintain swab in piping and pull past each joint as completed.

L. Install soil and waste and vent piping at the following minimum slopes unless otherwise indicated:
1. Building Sanitary Waste: 2 percent downward in direction of flow for piping NPS 3 and smaller; 1 percent downward in direction of flow for piping NPS 4 and larger.
2. Horizontal Sanitary Waste Piping: 2 percent downward in direction of flow.
3. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.

M. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
1. Install encasement on underground piping according to ASTM A 674 or AWWA C105/A 21.5.

N. Install steel piping according to applicable plumbing code.

O. Install underground PVC piping according to ASTM D 2321.

P. Install aboveground copper tubing according to CDA's "Copper Tube Handbook."

Q. Install force mains at elevations indicated.

R. Plumbing Specialties:
1. Install backwater valves in sanitary waster gravity-flow piping.
    a. Comply with requirements for backwater valves specified in Section 22 13 19 "Sanitary Waste Piping Specialties."
2. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers in sanitary waste gravity-flow piping.
    a. Install cleanout fitting with closure plug inside the building in sanitary drainage force-main piping.
    b. Comply with requirements for cleanouts specified in Section 22 13 19 "Sanitary Waste Piping Specialties."
3. Install drains in sanitary waste gravity-flow piping.
    a. Comply with requirements for drains specified in Section 22 13 19 "Sanitary Waste Piping Specialties."

S. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

T. Install sleeves for piping penetrations of walls, ceilings, and floors.

1. Comply with requirements for sleeves specified in Section 22 05 17 "Sleeves and Sleeve Seals for Plumbing Piping."

U. Install sleeve seals for piping penetrations of concrete walls and slabs.
1. Comply with requirements for sleeve seals specified in Section 22 05 17 "Sleeves and Sleeve Seals for Plumbing Piping."

V. Install escutcheons for piping penetrations of walls, ceilings, and floors.
1. Comply with requirements for escutcheons specified in Section 22 05 18 "Escutcheons for Plumbing Piping."

3.3 JOINT CONSTRUCTION

A. Join hub-and-spigot, cast-iron soil piping with gasket joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.

B. Join hub-and-spigot, cast-iron soil piping with calked joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for lead-and-oakum calked joints.

C. Join hubless, cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-piping coupling joints.

D. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1.
1. Cut threads full and clean using sharp dies.
2. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
   a. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
   b. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
   c. Do not use pipe sections that have cracked or open welds.

E. Plastic, Nonpressure-Piping, Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
2. PVC Piping: Join according to ASTM D 2855 and ASTM D 2665 appendixes.

F. Join copper tube and fittings with soldered joints according to ASTM B 828. Use ASTM B 813, water-flushable, lead-free flux and ASTM B 32, lead-free-alloy solder.

3.4 SPECIALTY PIPE FITTING INSTALLATION

A. Transition Couplings:
1. Install transition couplings at joints of piping with small differences in ODs.
2. In Waste Drainage Piping: Shielded, nonpressure transition couplings.
3. In Aboveground Force Main Piping: Fitting-type transition coupling.

B. Dielectric Fittings:
1. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
2. Dielectric Fittings for NPS 2 and Smaller: Use dielectric nipples or unions.
3. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric flanges.
4. Dielectric Fittings for NPS 5 and Larger: Use dielectric flange kits.

3.5 VALVE INSTALLATION

A. General valve installation requirements for general-duty valve installation are specified in the following Sections:
   1. Section 220523.12 "Ball Valves for Plumbing Piping."
   2. Section 220523.13 "Butterfly Valves for Plumbing Piping."
   3. Section 220523.14 "Check Valves for Plumbing Piping."
   4. Section 220523.15 "Gate Valves for Plumbing Piping."

B. Shutoff Valves:
   1. Install shutoff valve on each sewage pump discharge.
   2. Install full-port ball valve for piping NPS 3 and smaller.

C. Check Valves: Install swing check valve, between pump and shutoff valve, on each sewage pump discharge.
   1. Mount valves in horizontal or up to 45 degree from horizontal orientation.

D. Backwater Valves: Install backwater valves in piping subject to backflow.
   1. Horizontal Piping: Horizontal backwater valves. Use normally closed type unless otherwise indicated.
   2. Install backwater valves in accessible locations.
   3. Comply with requirements for backwater valve specified in Section 22 13 19 "Sanitary Waste Piping Specialties."

3.6 INSTALLATION OF HANGERS AND SUPPORTS

A. Comply with requirements for pipe hanger and support devices and installation specified in Section 22 05 29 "Hangers and Supports for Plumbing Piping and Equipment," and Section 22 05 48.13 “Vibration Controls for Plumbing Piping and Equipment”.
   1. Install carbon-steel pipe hangers for horizontal piping in noncorrosive environments.
   2. Install carbon-steel pipe support clamps for vertical piping in noncorrosive environments.
   3. Vertical Piping: MSS Type 8 or Type 42, clamps.
   4. Install individual, straight, horizontal piping runs:
      a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
      b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
      c. Longer Than 100 Feet if Indicated: MSS Type 49, spring cushion rolls.
   5. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
   6. Base of Vertical Piping: MSS Type 52, spring hangers.

B. Install hangers for cast-iron soil piping, with maximum horizontal spacing and minimum rod diameters, to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

C. Install hangers for PVC piping, with maximum horizontal spacing and minimum rod diameters, to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

D. Support horizontal piping and tubing within 12 inches of each fitting, valve, and coupling.

E. Support vertical runs of cast iron soil piping to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

F. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inch minimum rods.

G. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:
   1. NPS 1-1/2 and NPS 2: 60 inches with 3/8-inch rod.
   2. NPS 3: 60 inches with 1/2-inch rod.
   3. NPS 4 and NPS 5: 60 inches with 5/8-inch rod.
   4. NPS 6 and NPS 8: 60 inches with 3/4-inch rod.
   5. NPS 10 and NPS 12: 60 inches with 7/8-inch rod.
   6. Spacing for 10-foot pipe lengths may be increased to 10 feet. Spacing for fittings is limited to 60 inches.

H. Install supports for vertical cast-iron soil piping every 15 feet.

I. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:
   1. NPS 1-1/4: 84 inches with 3/8-inch rod.
   2. NPS 1-1/2: 108 inches with 3/8-inch rod.
   3. NPS 2: 10 feet with 3/8-inch rod.
   4. NPS 3: 10 Feet with 3/8-inch rod.
   5. NPS 4: 10 feet with 1/2-inch rod.

J. Install supports for vertical steel piping every 15 feet.

K. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
   1. NPS 1-1/4: 72 inches with 3/8-inch rod.
   2. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
   3. NPS 3 and NPS 4: 10 feet with 3/8-inch rod.

L. Install supports for vertical copper tubing every 10 feet.

M. Support piping and tubing not listed above according to MSS SP-58 and manufacturer's written instructions.

3.7 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.

C. Connect waste and vent piping to the following:
   1. Plumbing Fixtures: Connect waste piping in sizes indicated, but not smaller than required by plumbing code.
   2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
   3. Plumbing Specialties: Connect waste and vent piping in sizes indicated, but not smaller than required by plumbing code.
   4. Install test tees (wall cleanouts) in conductors near floor and floor cleanouts with cover flush with floor.
   5. Install horizontal backwater valves with cleanout cover flush with floor or in pit with pit cover flush with floor.
   6. Comply with requirements for backwater valves, cleanouts and drains specified in Section 22 13 19 "Sanitary Waste Piping Specialties."
   7. Equipment: Connect waste piping as indicated.

a. Provide shutoff valve if indicated and union for each connection.
b. Use flanges instead of unions for connections NPS 2-1/2 and larger.

D. Connect force-main piping to the following:
1. Sewage Pump: To sewage pump discharge.

E. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.

F. Make connections according to the following unless otherwise indicated:
1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.

3.8 IDENTIFICATION

A. Identify exposed sanitary waste and vent piping.

B. Comply with requirements for identification specified in Section 22 05 53 "Identification for Plumbing Piping and Equipment."

3.9 FIELD QUALITY CONTROL

A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.

C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

D. Test sanitary waste and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired.
a. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
2. Leave uncovered and unconcealed new, altered, extended, or replaced waste and vent piping until it has been tested and approved.
a. Expose work that was covered or concealed before it was tested.
3. Roughing-in Plumbing Test Procedure: Test waste and vent piping except outside leaders on completion of roughing-in.
a. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water.
b. From 15 minutes before inspection starts to completion of inspection, water level must not drop.
c. Inspect joints for leaks.
4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight.

a. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1-inch wg.
b. Use U-tube or manometer inserted in trap of water closet to measure this pressure.
c. Air pressure must remain constant without introducing additional air throughout period of inspection.
d. Inspect plumbing fixture connections for gas and water leaks.

5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
6. Prepare reports for tests and required corrective action.

E. Test force-main piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
1. Leave uncovered and unconcealed new, altered, extended, or replaced force-main piping until it has been tested and approved.
a. Expose work that was covered or concealed before it was tested.
2. Cap and subject piping to static-water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials.
a. Isolate test source and allow to stand for four hours.
b. Leaks and loss in test pressure constitute defects that must be repaired.
3. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
4. Prepare reports for tests and required corrective action.

F. Piping will be considered defective if it does not pass tests and inspections.

3.10 TELEVISION INSPECTION

A. The contractor shall video inspect all sections of lines below the first-floor slab. Video inspection shall not be done until the pipe is laid and has passed the required leakage test.

B. Preparation for Video Inspection: Just prior to performing the video inspection, water will be to ensure that any area where ponding is possible will be filled with water.

C. Video Camera and Video Tape Equipment:
1. The video cameras and video cassette's recorder shall record in color. Lighting and camera quality shall be suitable to allow a clear, in-focus picture for the entire inside periphery of pipelines. The replay of the recorded video information shall be free of electrical interference and shall provide a clear stable image.
2. The videotaping and monitoring equipment shall have the capability to instantly review video quality of the video tape production at all times, with still picture reproduction also available. The video shall be furnished by the contractor and shall become the property of the University.

D. Operations:
1. The operating technician shall have control of the movement of the television camera at all times. The travel speed of the camera shall be variable but uniform, and shall not exceed 45 feet per minute while viewing. Any means of propelling the camera through the sewer lines which would produce nonuniform or jerky movements will not be acceptable. As directed by the University Inspector, the camera shall be stopped to view and analyze conditions that appear unusual or uncommon. The operating technicians shall at all times be able to move the camera through the lines in either direction without the loss of quality in the video presentation on the monitor.
2. Footage shall appear on the screen as well as the picture of the interior of the pipe and shall become a part of the video cassette record.

E. Inspection Records:
1. In addition to the video, a certified inspection report detailing the physical condition of each of the sewer mains scheduled for inspection shall be submitted to the University. Each main shall be reported individually providing the following information:
a. The log shall contain the project name, inspector's name, date of inspection, client's name, pipe size, type of pipe, and tape footage reference number.
b. The direction of flow and the direction of the camera shall be indicated as well as the section length.

F. Acceptance:
1. Any of the following observations shall be considered defects that will require corrections prior to acceptance.
a. Ponding greater than 10 percent of the nominal pipe inside diameter or over 25 feet in length will be cause for rejection of the pipe segment.
b. Joint separations - over 3/4 inch (18 mm).
c. Offset joints.
d. Chips in pipe ends - none more than 1/4 inch (6 mm) deep;
e. Cracked or damaged pipe or evidence of the presence of an external object bearing upon the pipe (rocks, roots, etc.).
f. Infiltration.
g. Debris or other foreign objects.
h. Other obvious deficiencies when compared to Approved Plans and Specifications and Standard Drawings.
i. The contractor shall be notified in writing of and deficiencies revealed by the television inspection that will require repair, following which the contractor shall excavate and make the necessary repairs and request a television re-inspection. Television re-inspection shall be at the contractor’s expense.

3.11 CLEANING AND PROTECTION

A. Clean interior of piping. Remove dirt and debris as work progresses.

B. Protect sanitary waste and vent piping during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

C. Place plugs in ends of uncompleted piping at end of day and when work stops.

D. Repair damage to adjacent materials caused by waste and vent piping installation.

3.12 PIPING SCHEDULE

A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.

B. Aboveground, soil and waste piping NPS 4 and smaller shall be the following:
1. Hubless, cast-iron soil pipe and fittings; hubless-piping couplings; and coupled joints.

C. Aboveground, soil and waste piping NPS 5 and larger shall be the following:
1. Hubless, cast-iron soil pipe and fittings; CISPI hubless-piping couplings; and coupled joints.

D. Aboveground, vent piping NPS 4 and smaller shall be the following:
1. Hubless, cast-iron soil pipe and fittings; CISPI hubless-piping couplings; and coupled joints.

E. Aboveground, vent piping NPS 5 and larger shall be the following:
1. Hubless, cast-iron soil pipe and fittings; CISPI hubless-piping couplings; and coupled joints.

F. Aboveground sanitary-sewage force mains NPS 1-1/2 to NPS 4 shall be any of the following:
   1. Galvanized-steel pipe, pressure fittings, and threaded joints.
   2. Hard copper tube, Type L; copper pressure fittings, and soldered joints.

G. Underground, soil, waste, and vent piping NPS 4 and smaller shall be any of the following:
   1. Extra Heavy class, cast-iron soil piping; gaskets; and gasketed joints.
   2. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.

H. Underground, soil and waste piping NPS 5 and larger shall be any of the following:
   1. Extra Heavy class, cast-iron soil piping; gaskets; and gasketed joints.
   2. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.

I. Aboveground sanitary-sewage force mains NPS 1-1/2 and NPS 2 shall be any of the following:
   1. Hard copper tube, Type L; copper pressure fittings; and soldered joints.
   2. Hard copper tube, Type L; copper pressure fittings; and pressure-sealed joints.
   3. Galvanized-steel pipe, pressure fittings, and threaded joints.

J. Aboveground sanitary-sewage force mains NPS 2-1/2 to NPS 4 shall be any of the following:
   1. Hard copper tube, Type L; copper pressure fittings; and soldered joints.
   2. Galvanized-steel pipe, pressure fittings, and threaded joints.

END OF SECTION

THIS PAGE IS INTENTIONALLY LEFT BLANK.

SECTION 22 13 19 - SANITARY WASTE PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Cleanouts.
2. Roof flashing assemblies.
3. Through-penetration firestop assemblies.
4. Miscellaneous sanitary drainage piping specialties.

B. Related Requirements:

1. Section 22 14 23 "Storm Drainage Piping Specialties" for trench drains for storm water, channel drainage systems for storm water, roof drains, and catch basins.
2. Section 33 42 00 "Stormwater Conveyance" for storm drainage piping and piping specialties outside the building.

1.3 ACTION SUBMITTALS

A. Shop Drawings:

1. Show fabrication and installation details for frost-resistant vent terminals.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For sanitary waste piping specialties to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.1 ASSEMBLY DESCRIPTIONS

A. Sanitary waste piping specialties shall bear label, stamp, or other markings of specified testing agency.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing, and marked for intended location and application.

2.2 CLEANOUTS

A. Cast-Iron Exposed Cleanouts:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Jay R. Smith Mfg. Co.
b. Josam Company.
c. MIFAB, Inc.
d. Tyler Pipe; a subsidiary of McWane Inc.
e. WATTS.

2. Standard: ASME A112.36.2M.
3. Size: Same as connected drainage piping
4. Body Material: Hubless, cast-iron soil pipe test tee as required to match connected piping.
5. Closure: Countersunk or raised-head plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.

B. Cast-Iron Exposed Floor Cleanouts:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Jay R. Smith Mfg. Co.
b. Josam Company.
c. MIFAB, Inc.
d. Tyler Pipe; a subsidiary of McWane Inc.
e. WATTS.

2. Standard: ASME A112.36.2M for heavy-duty, adjustable housing cleanout.
3. Size: Same as connected branch.
4. Type: Threaded, adjustable housing.
5. Body or Ferrule: Cast iron.
6. Clamping Device: Not required.
7. Outlet Connection: Inside calk.
8. Closure: Brass plug with straight threads and gasket.
9. Adjustable Housing Material: Cast iron with threads, setscrews or other device.
10. Frame and Cover Material and Finish: Nickel-bronze, copper alloy.
11. Frame and Cover Shape: Round.
12. Top Loading Classification: Heavy Duty.
13. Riser: ASTM A74, Extra-Heavy class, cast-iron drainage pipe fitting and riser to cleanout.

C. Cast-Iron Wall Cleanouts:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Jay R. Smith Mfg. Co.
b. Josam Company.
c. MIFAB, Inc.
d. Tyler Pipe; a subsidiary of McWane Inc.
e. WATTS.

2. Standard: ASME A112.36.2M. Include wall access.
3. Size: Same as connected drainage piping.
4. Body: Hubless, cast-iron soil pipe test tee as required to match connected piping.
5. Closure Plug:

    a. Cast iron.
    b. Countersunk head.
    c. Drilled and threaded for cover attachment screw.
    d. Size: Same as or not more than one size smaller than cleanout size.

6. Wall Access: Round, deep, chrome-plated bronze cover plate with screw.
7. Wall Access: [Round, nickel-bronze, copper-alloy, or stainless-steel wall-installation frame and cover.

2.3 ROOF FLASHING ASSEMBLIES

A. Roof Flashing Assemblies:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Acorn Engineering Company.
    b. Thaler Metal Industries Ltd.
    c. ZURN Industries.

2. Description: Manufactured assembly made of 6.0-lb/sq. ft., 0.0938-inch- thick, lead flashing collar and skirt extending at least 8 inches from pipe, with galvanized-steel boot reinforcement and counterflashing fitting.

    a. Open-Top Vent Cap: Without cap.
    b. Low-Silhouette Vent Cap: With vandal-proof vent cap.
    c. Extended Vent Cap: With field-installed, vandal-proof vent cap.

2.4 THROUGH-PENETRATION FIRESTOP ASSEMBLIES

A. Through-Penetration Firestop Assemblies:

1. Standard: UL 1479 assembly of sleeve-and-stack fitting with firestopping plug.
2. Size: Same as connected soil, waste, or vent stack.
3. Sleeve: Molded-PVC plastic, of length to match slab thickness and with integral nailing flange on one end for installation in cast-in-place concrete slabs.
4. Stack Fitting: ASTM A48/A48M, gray-iron, hubless-pattern wye branch with neoprene O-ring at base and gray-iron plug in thermal-release harness. Include PVC protective cap for plug.
5. Special Coating: Corrosion resistant on interior of fittings.

2.5 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

A. Open Drains:

1. Description: Shop or field fabricate from ASTM A74, Service class, hub-and-spigot, cast-iron soil-pipe fittings. Include P-trap, hub-and-spigot riser section; and where required, increaser fitting joined with ASTM C564 rubber gaskets.
2. Size: Same as connected waste piping with increaser fitting of size indicated.

B. Deep-Seal Traps:

1. Description: Cast-iron or bronze casting, with inlet and outlet matching connected piping and cleanout trap-seal primer valve connection.
2. Size: Same as connected waste piping.
   a. NPS 2: 4-inch-minimum water seal.
   b. NPS 2-1/2 and Larger: 5-inch-minimum water seal.

C. Floor-Drain, Inline Trap Seal:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Green Drain, Inc.
   b. RectorSeal Plumbing: A CSW Industrials Company.
   c. Zurn Industries.

2. Description: Inline floor drain trap seal, forming a physical barrier to slow trap evaporation while not impeding flow from drain.
3. Material: Polymer.
4. Standard: Tested and certified in accordance with ASSE 1072.
5. Listing: ICC-ES or IAPMO listed.
6. Size: Same as floor drain outlet or strainer throat.

D. Air-Gap Fittings:

1. Standard: ASME A112.1.2, for fitting designed to ensure fixed, positive air gap between installed inlet and outlet piping.
2. Body: Bronze or cast iron.
3. Inlet: Opening in top of body.
4. Outlet: Larger than inlet.
5. Size: Same as connected waste piping and with inlet large enough for associated indirect waste piping.

E. Sleeve Flashing Device:

1. Description: Manufactured, cast-iron fitting, with clamping device that forms sleeve for pipe floor penetrations of floor membrane. Include galvanized-steel pipe extension in top of fitting that will extend 2 inches above finished floor and galvanized-steel pipe extension in bottom of fitting that will extend through floor slab.
2. Size: As required for close fit to riser or stack piping.

F. Stack Flashing Fittings:

1. Description: Counterflashing-type, cast-iron fitting, with bottom recess for terminating roof membrane, and with threaded or hub top for extending vent pipe.
2. Size: Same as connected stack vent or vent stack.

G. Frost-Resistant Vent Terminals:

1. Description: Manufactured or shop-fabricated assembly constructed of copper, lead-coated copper, or galvanized steel.
2. Design: To provide 1-inch enclosed air space between outside of pipe and inside of flashing collar extension, with counterflashing.

H. Expansion Joints:

1. Standard: ASME A112.6.4.
2. Body: Cast iron with bronze sleeve, packing, and gland.
3. End Connections: Matching connected piping.
4. Size: Same as connected soil, waste, or vent piping.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install backwater valves in building drain piping.

1. For interior installation, provide cleanout deck plate flush with floor and centered over backwater valve cover, and of adequate size to remove valve cover for servicing.

B. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:

1. Size same as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
2. Locate at each change in direction of piping greater than 45 degrees.
3. Locate at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
4. Locate at base of each vertical soil and waste stack.

C. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.

D. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.

E. Install roof flashing assemblies on sanitary stack vents and vent stacks that extend through roof. Comply with requirements in Section 07 62 00 "Sheet Metal Flashing and Trim."

F. Install flashing fittings on sanitary stack vents and vent stacks that extend through roof. Comply with requirements in Section 07 62 00 "Sheet Metal Flashing and Trim."

G. Assemble open drain fittings and install with top of hub 2 inches above floor.

H. Install deep-seal traps on floor drains and other waste outlets, if indicated.

I. Install floor-drain, trap-seal primer fittings on inlet to floor drains that require trap-seal primer connection.

1. Exception: Fitting may be omitted if trap has trap-seal primer connection.
2. Size: Same as floor drain inlet.

J. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.

K. Install sleeve and sleeve seals with each riser and stack passing through floors with waterproof membrane.

L. Install frost-resistant vent terminals on each vent pipe passing through roof. Maintain 1-inch clearance between vent pipe and roof substrate.

M. Install expansion joints on vertical stacks and conductors. Position expansion joints for easy access and maintenance.

N. Install wood-blocking reinforcement for wall-mounting-type specialties.

O. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.

3.2 CONNECTIONS

A. Comply with requirements in Section 22 13 16 "Sanitary Waste and Vent Piping" for piping installation requirements. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment to allow service and maintenance.

3.3 FLASHING INSTALLATION

A. Comply with requirements in Section 07 62 00 "Sheet Metal Flashing and Trim."

B. Fabricate flashing from single piece unless large pans, sumps, or other drainage shapes are required.

C. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.

1. Pipe Flashing: Sleeve type, matching pipe size, with minimum length of 10 inches, and skirt or flange extending at least 8 inches around pipe.
2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches around sleeve.
3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches around specialty.

D. Set flashing on floors and roofs in solid coating of bituminous cement.

E. Secure flashing into sleeve and specialty clamping ring or device.

F. Install flashing for piping passing through roofs with counterflashing or commercially made flashing fittings, according to Section 07 62 00 "Sheet Metal Flashing and Trim."

G. Extend flashing up vent pipe passing through roofs and turn down into pipe, or secure flashing into cast-iron sleeve having calking recess.

3.4 LABELING AND IDENTIFYING

A. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit.

1. Nameplates and signs are specified in Section 22 05 53 "Identification for Plumbing Piping and Equipment."

3.5 FIELD QUALITY CONTROL

A. Tests and Inspections:
   1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
   2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.6 PROTECTION

A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.

B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION

THIS PAGE INTENTIONALLY LEFT BLANK.

SECTION 22 13 19.13 - SANITARY DRAINS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Floor drains.
2. Floor sinks.

1.3 DEFINITIONS

A. ABS: Acrylonitrile-butadiene styrene.

B. FRP: Fiberglass-reinforced plastic.

C. HDPE: High-density polyethylene.

D. PE: Polyethylene.

E. PP: Polypropylene.

F. PVC: Polyvinyl chloride.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 DRAIN ASSEMBLIES

A. Sanitary drains shall bear label, stamp, or other markings of specified testing agency.

2.2 FLOOR DRAINS

A. Cast Iron: Finished Areas.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Jay R. Smith Mfg. Co.
b. Josam Company.
c. MIFAB, Inc.
d. WATTS.
e. Zurn Industries.

2. Standard: ASME A112.6.3.
3. Pattern: Floor drain.
4. Body Material: Cast Iron.
5. Seepage Flange: Required.
6. Anchor Flange: Required.
7. Clamping Device: Not required.
8. Outlet: Bottom.
9. Coating on Interior and Exposed Exterior Surfaces: Not required.
10. Sediment Bucket: Not required.
11. Top or Strainer Material: Polished nickel bronze top.
12. Top Shape: Round.
13. Top Loading Classification: Medium Duty.
14. Funnel: Not required.
15. Inlet Fitting: Stainless steel, with threaded inlet and threaded or spigot outlet, and trap-seal primer valve connection.
16. Trap Material: Cast iron.
17. Trap Pattern: Standard P-trap.

B. Cast-Iron Floor Drains: Mechanical Rooms.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Jay R. Smith Mfg. Co.
    b. Josam Company.
    c. MIFAB, Inc.
    d. WATTS.
    e. Zurn Industries.

2. Standard: ASME A112.6.3.
3. Pattern: Floor drain.
4. Body Material: Gray iron.
5. Seepage Flange: Required.
6. Anchor Flange: Required.
7. Clamping Device: Not required.
8. Outlet: Bottom.
9. Coating on Interior and Exposed Exterior Surfaces: Not required.
10. Sediment Bucket: Not required.
11. Top or Strainer Material: Gray iron.
12. Top of Body and Strainer Finish: Rough bronze.
13. Top Shape: Round.
14. Top Loading Classification: Extra Heavy Duty.
15. Funnel: Not required.
16. Inlet Fitting: Gray iron, with threaded inlet and threaded or spigot outlet, and trap-seal primer valve connection.
17. Trap Material: Cast iron.
18. Trap Pattern: Standard P-trap.

C. Cast-Iron Floor Drains: Garage.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Jay R. Smith Mfg. Co.
    b. Josam Company.
    c. MIFAB, Inc.

d. WATTS.
e. Zurn Industries.

2. Standard: ASME A112.6.3.
3. Pattern: Floor drain.
4. Body Material: Gray iron.
5. Seepage Flange: Required.
6. Anchor Flange: Required.
7. Clamping Device: Not required.
8. Outlet: Bottom.
9. Coating on Interior and Exposed Exterior Surfaces: Not required.
10. Sediment Bucket: Required.
11. Top or Strainer Material: Gray iron.
12. Top of Body and Strainer Finish: Rough bronze.
13. Top Shape: Round.
14. Top Loading Classification: Extra Heavy Traffic Duty.
15. Funnel: Not required.
16. Inlet Fitting: Gray iron, with threaded inlet and threaded or spigot outlet.
17. Trap Material: Not required.

D. Trap Pattern: Standard P-trap. Stainless Steel Linear Floor Drains: Showers
1.

2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Jay R. Smith Mfg. Co.
b. Josam Company.
c. MIFAB, Inc.
d. WATTS.
e. Zurn Industries.

3. Standard: ASME A112.6.3.
4. Pattern: Linear Floor drain.
5. Body Material: 304 stainless steel.
6. Seepage Flange: Required.
7. Anchor Supports: Adjustable.
8. Clamping Device: Not required.
9. Outlet: Bottom.
10. Coating on Interior and Exposed Exterior Surfaces: Not required.
11. Sediment Bucket: Not required.
12. Top or Strainer Material: Stainless steel.
13. Top of Body and Strainer Finish: Stainless steel.
14. Top Shape: Linear, length as indicated.
15. Top Loading Classification: Light duty.
16. Funnel: Not required.
17. Trap Material: Cast iron.
18. Trap Pattern: Standard P-trap.

2.3 FLOOR SINKS

A. Cast-Iron Floor Sinks:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Jay R. Smith Mfg. Co.
b. Josam Company.
c. MIFAB, Inc.
d. WATTS.
e. Zurn Industries.

2. Standard: ASME A112.6.7.
3. Pattern: Floor drain.
4. Body Material: Cast iron.
5. Anchor Flange: Required.
6. Clamping Device: Required.
7. Outlet: Bottom, connection.
8. Coating on Interior Surfaces: Acid-resistant enamel.
9. Sediment Bucket: <Insert description>.
10. Internal Strainer: Dome.
11. Internal Strainer Material: Aluminum.
12. Top Grate Material: Cast iron.
13. Top of Body and Grate Finish: Nickel bronze.
14. Top Shape: Square.
15. Top Loading Classification: No traffic.
16. Funnel: Not required.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.

1. Position floor drains for easy access and maintenance.
2. Set floor drains below elevation of surrounding finished floor to allow floor drainage.
3. Set with grates depressed according to the following drainage area radii:

a. Radius, 30 Inches or Less: Equivalent to 1 percent slope, but not less than 1/4-inch total depression.
b. Radius, 30 to 60 Inches: Equivalent to 1 percent slope.
c. Radius, 60 Inches or Larger: Equivalent to 1 percent slope, but not greater than 1-inch total depression.

4. Install floor-drain flashing collar or flange, so no leakage occurs between drain and adjoining flooring.

a. Maintain integrity of waterproof membranes where penetrated.

5. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.

B. Install open drain fittings with top of hub 2 inches above floor.

3.2 CONNECTIONS

A. Comply with requirements in Section 22 13 16 "Sanitary Waste and Vent Piping" for piping installation requirements. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Comply with requirements in Section 22 13 19 "Sanitary Waste Piping Specialties" for backwater valves, air admittance devices and miscellaneous sanitary drainage piping specialties.

C. Install piping adjacent to equipment to allow service and maintenance.

3.3 LABELING AND IDENTIFYING

A. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Section 22 05 53 "Identification for Plumbing Piping and Equipment."

3.4 PROTECTION

A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.

B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION

THIS PAGE IS INTENTIONALLY LEFT BLANK.

SECTION 22 13 23 - SANITARY WASTE INTERCEPTORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Sand interceptors.

1.3 DEFINITIONS

A. FRP: Fiberglass-reinforced plastic.

B. PP: Polypropylene.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of interceptor. Include materials of fabrication, dimensions, rated capacities, retention capacities, operating characteristics, size and location of each pipe connection, furnished specialties, and accessories.

B. Shop Drawings: For each type and size of precast-concrete interceptor indicated.

1. Include materials of construction, dimensions, rated capacities, retention capacities, location and size of each pipe connection, furnished specialties, and accessories.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Interceptors, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Piping connections. Include size, location, and elevation of each.
2. Interface with underground structures and utility services.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For sanitary waste interceptors to include in emergency, operation, and maintenance manuals.

1.7 FIELD CONDITIONS

A. Interruption of Existing Sewer Services: Do not interrupt services to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary sewer services according to requirements indicated:

1. Notify Owner no fewer than 7 days in advance of proposed interruption of service.
2. Do not proceed with interruption of sewer services without Owner's written permission.

PART 2 - PRODUCTS

2.1 SAND INTERCEPTORS

A. Description: Factory-fabricated, cast-iron or steel body and inlet grate; with settlement chamber and removable basket or strainer.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Jay R. Smith Mfg Co; a division of Morris Group International.
2. MIFAB, Inc.
3. Zurn Industries, LLC.

C. Outlet Piping Connection: Hub, hubless, or threaded, unless otherwise indicated.

D. Grate: Cast iron or steel with reinforcement to provide ASTM C890, A-03, heavy duty load.

E. Capacities and Characteristics:

1. See Equipment Schedules.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Excavating, trenching, and backfilling are specified in Section 312000 "Earth Moving."

3.2 INSTALLATION

A. Equipment Mounting:

1. Install interceptors on cast-in-place concrete equipment base(s).
2. Comply with requirements for equipment bases and foundations specified in Section 033000 "Cast-in-Place Concrete."

B. Install precast concrete interceptors according to ASTM C891.

C. Set interceptors level and plumb.

D. Install manhole risers from top of underground concrete interceptors to manholes and gratings at finished grade.

E. Set tops of manhole frames and covers flush with finished surface in pavements.

F. Set tops of metal interceptor covers flush with finished surface in pavements.

G. Install interceptors, including trapping, venting, and flow-control fitting, according to authorities having jurisdiction and with clear space for servicing.

3.3 PIPING CONNECTIONS

A. Piping installation requirements are specified in Section 221316 "Sanitary Waste and Vent Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

B. Make piping connections between interceptors and piping systems.

3.4 IDENTIFICATION

A. Identification materials and installation are specified in Section 312000 "Earth Moving."

1. Arrange for installation of green warning tapes directly over piping and at outside edges of underground interceptors.
2. Use warning tapes or detectable warning tape over ferrous piping.
3. Use detectable warning tape over nonferrous piping and over edges of underground structures.

B. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:

1. Solids interceptors.

3.5 PROTECTION

A. Protect sanitary waste interceptors from damage during construction period.

B. Repair damage to adjacent materials caused by sanitary waste interceptor installation.

END OF SECTION

THIS PAGE IS INTENTIONALLY LEFT BLANK.

SECTION 22 14 13 - FACILITY STORM DRAINAGE PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Hub-and-spigot, cast-iron soil pipe and fittings.
2. Hubless, cast-iron soil pipe and fittings.
3. Galvanized-steel pipe and fittings.
4. Copper tube and fittings.
5. Encasement for underground metal piping.
6. Geotextile filter fabrics.

B. Related Requirements:

1. Section 22 14 29 “Sump Pumps” for storm drainage pumps.
2. Section 33 44 00 “Stormwater Utility Equipment” for storm drainage piping outside the building.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:

1. Product Data: For adhesives, indicating VOC content.
2. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting materials.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Detail storm drainage piping. Show support locations, type of support, weight on each support, required clearances, and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Structural members to which drainage piping will be attached or suspended from.

B. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

1.6 FIELD CONDITIONS

A. Interruption of Existing Storm Drainage Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:

1. Do not proceed with interruption of storm drainage without Owner's written permission.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Components and installation shall be capable of withstanding the following minimum working pressure unless otherwise indicated:

1. Storm Drainage Piping: 10-foot head of water.
2. Storm Drainage, Force-Main Piping: 50 psig.

2.2 PIPING MATERIALS

A. Piping materials to bear label, stamp, or other markings of specified testing agency.

B. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.3 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. AB & I Foundry; a part of the McWane family of companies.
2. Charlotte Pipe and Foundry Company.
3. Tyler Pipe Company.

B. Pipe and Fittings:

1. Marked with CISPI collective trademark and NSF certification mark.
2. Class: ASTM A 74, Service and Extra Heavy class(es).

C. Gaskets: ASTM C 564, rubber.

2.4 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. AB & I Foundry; a part of the McWane family of companies.

2. Charlotte Pipe and Foundry Company.
3. Tyler Pipe Company.

B. Pipe and Fittings:

1. Marked with CISPI collective trademark and NSF certification mark.
2. Standard: ASTM A 888 or CISPI 301.

C. CISPI, Hubless-Piping Couplings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. ANACO-Husky.
   b. Charlotte Pipe and Foundry Company.
   c. Fernco Inc.
   d. MIFAB, Inc.

2. Couplings shall bear CISPI collective trademark and NSF certification mark.
3. Standards: ASTM C 1277 and CISPI 310.
4. Description: Stainless-steel corrugated shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

D. Heavy-Duty, Hubless-Piping Couplings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. ANACO-Husky.
   b. Charlotte Pipe and Foundry Company.
   c. MIFAB, Inc.

2. Standard: ASTM C 1540.
3. Description: Stainless-steel shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

E. Cast-Iron, Hubless-Piping Couplings:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

   a. Charlotte Pipe and Foundry Company.
   b. MIFAB, Inc.
   c. Tyler Pipe Company.

2. Standard: ASTM C 1277.
3. Description: Two-piece ASTM A 48/A 48M, cast-iron housing; stainless-steel bolts and nuts; and ASTM C 564, rubber sleeve with integral, center pipe stop.

2.5 GALVANIZED-STEEL PIPE AND FITTINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Tubular USA.
2. U.S. Steel.
3. Wheatland Tube Company.

B. Pipe: ASTM A 53/A 53M, Type E, Standard Weight class. Include square-cut-grooved or threaded ends matching joining method.

C. Steel-Pipe Pressure Fittings:

1. Galvanized-Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M or ASTM A 106/A 106M, Schedule 40, seamless steel pipe. Include ends matching joining method.
2. Malleable-Iron Unions: ASME B16.39; Class 150; hexagonal-stock body with ball-and-socket, metal-to-metal, bronze seating surface; and female threaded ends.
3. Galvanized-Gray-Iron, Threaded Fittings: ASME B16.4, Class 125, standard pattern.

2.6 COPPER TUBE AND FITTINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cambridge-Lee Industries, LLC.
2. Cerro Flow Products, LLC.
3. Mueller Industries, Inc.

B. Copper Pressure Fittings:

1. Copper Fittings: ASME B16.18, cast-copper-alloy fittings or ASME B16.22, wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.
2. Copper Unions: MSS SP-123, copper-alloy, hexagonal-stock body with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.

C. Solder: ASTM B 32, lead free with ASTM B 813, water-flushable flux.

2.7 PERFORATED-WALL PIPES AND FITTINGS

A. Perforated PE Pipe and Fittings:

1. NPS 6 and Smaller: ASTM F 405 or AASHTO M 252, Type CP, corrugated, for coupled joints.
2. Couplings: Manufacturer’s standard, band type.
3. Provide Filter Fabric: Nonwoven needle-punched geotextile, manufactured from subsurface drainage, made from polyolefins or polyesters; with elongation greater than 50 percent; complying with the following properties determined according to AASHTO M 288.

a. Survivability: Class 2.
b. Apparent Opening Size: No. 60 sieve, maximum.

c. Permittivity: 0.2 per second, minimum.

2.8 GEOTEXTILE FILTER FABRICS

A. Description: Fabric of PP pr polyester fibers or combination of both, with flow ranges from 110 to 330 gpm/sq. ft. when tested according to ASTM D 4491.

B. Structure Type: Nonwoven, needle-punched continuous filament.

1. Survivability: AASHTO M288 Class 2.

2.9 ENCASEMENT FOR UNDERGROUND METAL PIPING

A. Standard: ASTM A 674 or AWWA C105/A 21.5.

B. Material: High-density, crosslaminated polyethylene film of 0.004-inch or linear low-density polyethylene film of 0.008-inch minimum thickness.

C. Form: Sheet or tube.

D. Color: Black or natural.

1. Styles: Flat or sock.

2.10 PVC PIPE AND FITTINGS

A. Solid-Wall PVC Pipe: ASTM D 2665, drain, waste, and vent.

B. PVC Socket Fittings: ASTM D 2665, made to ASTM D 3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.

C. Adhesive Primer: ASTM F 656.

1. Adhesive primer shall have a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

D. Solvent Cement: ASTM D 2564.

1. PVC solvent cement shall have a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.11 SPECIALTY PIPE FITTINGS

A. Transition Couplings:

1. General Requirements: Fitting or device for joining piping with small differences in OD's or of different materials. Include end connections same size as and compatible with pipes to be joined.
2. Fitting-Type Transition Couplings: Manufactured piping coupling or specified-piping-system fitting.

3. Shielded, Nonpressure Transition Couplings.

    a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

        1) Cascade Waterworks Mfg. Co.
        2) Mission Rubber Company; a division of MCP Industries, Inc.

    b. Standard: ASTM C 1460.
    c. Description: Elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.

B. Dielectric Fittings:

1. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.
2. Dielectric Unions:

    a. Description:

        1) Standard: ASSE 1079.
        2) Pressure Rating: 150 psig minimum at 180 deg F.
        3) End Connections: Solder-joint copper alloy and threaded ferrous.

3. Dielectric Nipples:

    a. Description: Electroplated steel nipple.
    b. Standards: ASTM F492, ASME B1.20.1.
    c. Pressure Rating: 300 psig at 225 deg F.
    d. End Connections: Male threaded or grooved.
    e. Lining: Inert and noncorrosive, propylene.

PART 3 - EXECUTION

3.1 EARTH MOVING

A. Comply with requirements for excavating, trenching, and backfilling specified in Section 31 20 00 "Earth Moving."

3.2 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems.

1. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations.
2. Install piping as indicated unless deviations from layout are approved on coordination drawings.

B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

E. Install piping to permit valve servicing.

F. Install piping at indicated slopes.

G. Install piping free of sags and bends.

H. Install fittings for changes in direction and branch connections.

I. Install piping to allow application of insulation.

J. Make changes in direction for piping using appropriate branches, bends, and long-sweep bends.

1. Do not change direction of flow more than 90 degrees.
2. Use proper size of standard increasers and reducers if pipes of different sizes are connected.

    a. Reducing size of drainage piping in direction of flow is prohibited.

K. Lay buried building piping beginning at low point of each system.

1. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream.
2. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements.
3. Maintain swab in piping and pull past each joint as completed.

L. Install piping at the following minimum slopes unless otherwise indicated:

1. Building Storm Drain: 2 percent downward in direction of flow for piping NPS 2-1/2 and smaller; 1 percent downward in direction of flow for piping NPS 3 and larger.

M. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."

1. Install encasement on underground piping according to ASTM A 674 or AWWA C105/A 21.5.

N. Install underground PVC piping according to ASTM D 2321.

O. Install steel piping according to applicable plumbing code.

P. Install aboveground copper tubing according to CDA’s “Copper Tube Handbook.”

Q. Install underground, copper, force-main tubing according to CDA’s “Copper Tube Handbook.”

1. Install encasement on piping according to ASTM A 674 or AWWA C105/A 21.5.

R. Install force mains at elevations indicated.

S. Plumbing Specialties:

1. Install backwater valves in storm drainage gravity-flow piping.

a. Comply with requirements for backwater valves specified in Section 22 14 23 "Storm Drainage Piping Specialties."

2. Install cleanouts at grade and extend to where building storm drains connect to building storm sewers in storm drainage gravity-flow piping.

a. Install cleanout fitting with closure plug inside the building in storm drainage force-main piping.
b. Comply with requirements for cleanouts specified in Section 22 14 23 "Storm Drainage Piping Specialties."

3. Install drains in storm drainage gravity-flow piping.

a. Comply with requirements for drains specified in Section 22 14 23 "Storm Drainage Piping Specialties."

T. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

U. Install sleeves for piping penetrations of walls, ceilings, and floors.

1. Comply with requirements for sleeves specified in Section 22 05 17 "Sleeves and Sleeve Seals for Plumbing Piping."

V. Install sleeve seals for piping penetrations of concrete walls and slabs.

1. Comply with requirements for sleeve seals specified in Section 22 05 17 "Sleeves and Sleeve Seals for Plumbing Piping."

W. Install escutcheons for piping penetrations of walls, ceilings, and floors.

1. Comply with requirements for escutcheons specified in Section 22 05 18 "Escutcheons for Plumbing Piping."

X. Perforate-wall Pipe: Install perforated-wall piping beginning at low points of system, true to grades and alignment indicated, with unbroken continuity of invert. Bed piping with full bearing in filtering material. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions and other requirements indicated.

1. Under-slab Subdrainage: Install piping level and with a minimum cover of 36 inches unless otherwise indicated.
2. Lay perforated pipe with perforations down.
3. Excavate recesses in trench bottom for bell ends of pipe. Lay pipe with bells facing upslope and with spigot end entered fully into adjacent bell.
4. Use increasers, reducers, and couplings made for different sizes or materials of pipes and fittings being connected. Reduction of pipe size in direction of flow is prohibited.

5. Install thermoplastic piping according to ASTM D 2321.

3.3 JOINT CONSTRUCTION

A. Hub-and-Spigot, Cast-Iron Soil Piping Gasketed Joints: Join according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.

B. Hubless, Cast-Iron Soil Piping Coupled Joints:

1. Join according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-piping coupling joints.

C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1.

1. Cut threads full and clean using sharp dies.
2. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

a. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
b. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
c. Do not use pipe sections that have cracked or open welds.

D. Join copper tube and fittings with soldered joints according to ASTM B 828 procedure. Use ASTM B 813, water-flushable, lead-free flux and ASTM B 32, lead-free-alloy solder.

E. Plastic, Nonpressure-Piping, Solvent-Cemented Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:

1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.

F. PVC Piping: Join according to ASTM D 2855 and ASTM D 2665 Appendixes.

3.4 SPECIALTY PIPE FITTING INSTALLATION

A. Transition Couplings:

1. Install transition couplings at joints of piping with small differences in OD's.
2. In Drainage Piping: Unshielded, nonpressure transition couplings.
3. In Aboveground Force-Main Piping: Fitting-type transition couplings.
4. In Underground Force-Main Piping:

a. NPS 1-1/2 and Smaller: Fitting-type transition couplings.
b. NPS 2 and Larger: Pressure transition couplings.

B. Dielectric Fittings:

1. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
2. Dielectric Fittings for NPS 2 and Smaller: Use dielectric nipples.

3.5 VALVE INSTALLATION

A. General valve installation requirements for general-duty valve installations are specified in the following Sections:

1. Section 22 05 23.12 "Ball Valves for Plumbing Piping."
2. Section 22 05 23.14 "Check Valves for Plumbing Piping."

B. Shutoff Valves:

1. Install shutoff valve on each sump pump discharge.
2. Install full port ball valve for piping NS 3 and smaller.

C. Check Valves: Install swing-check valve, between pump and shutoff valve, on each sump pump discharge.

1. Mount valve in 45 degree or less angle from horizontal piping.

D. Backwater Valves: Install backwater valves in piping subject to backflow.

1. Horizontal Piping: Horizontal backwater valves. Use normally closed type unless otherwise indicated.
2. Install backwater valves in accessible locations.
3. Comply with requirements for backwater valves specified in Section 22 14 23 "Storm Drainage Piping Specialties."

3.6 INSTALLATION OF HANGERS AND SUPPORTS

A. Comply with requirements for hangers, supports, and anchor devices specified in Section 22 05 29 "Hangers and Supports for Plumbing Piping and Equipment."

1. Install carbon-steel pipe hangers for horizontal piping in noncorrosive environments.
2. Install stainless-steel pipe hangers for horizontal piping in corrosive environments.
3. Install carbon-steel pipe support clamps for vertical piping in noncorrosive environments.
4. Vertical Piping: MSS Type 8 or Type 42, clamps.
5. Install individual, straight, horizontal piping runs:

a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
c. Longer Than 100 Feet if Indicated: MSS Type 49, spring cushion rolls.

6. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
7. Base of Vertical Piping: MSS Type 52, spring hangers.

B. Install hangers for cast-iron soil piping, with maximum horizontal spacing and minimum rod diameters, to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

C. Support horizontal piping and tubing within 12 inches of each fitting, valve, and coupling.

D. Support vertical cast-iron piping to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent, but as a minimum at base and at each floor.

E. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inch minimum rods.

F. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/2 and NPS 2: 60 inches with 3/8-inch rod.
2. NPS 3: 60 inches with 1/2-inch rod.
3. NPS 4 and NPS 5: 60 inches with 5/8-inch rod.
4. NPS 6 and NPS 8: 60 inches with 3/4-inch rod.
5. NPS 10 and NPS 12: 60 inches with 7/8-inch rod.
6. Spacing for 10-foot pipe lengths may be increased to 10 feet. Spacing for fittings is limited to 60 inches.

G. Install supports for vertical cast-iron soil piping every 15 feet.

H. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/4: 84 inches with 3/8-inch rod.
2. NPS 1-1/2: 108 inches with 3/8-inch rod.
3. NPS 2: 10 feet with 3/8-inch rod.

I. Install supports for vertical steel piping every 15 feet.

J. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/4: 72 inches with 3/8-inch rod.
2. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.

K. Install supports for vertical copper tubing every 10 feet.

L. Support piping and tubing not listed above according to MSS SP-58 and manufacturer's written instructions.

3.7 FOUNDATION DRAINAGE INSTALLATION

A. Place impervious fill material on subgrade adjacent to bottom of footing after concrete footing forms have been removed. Place and compact impervious fill to dimensions indicated, but not less than 6 inches deep and 12 inches wide.

B. Lay flat-style geotextile filter fabric in trance and overlap trench sides.

C. Place supporting layer of drainage course over compacted subgrade and geotextile filter fabric, to compacted depth of not less than 4 inches.

D. Encase pipe with sock-style geotextile filter fabric before installing pipe. Connect sock sections with adhesive.

E. Install drainage piping as indicated in Part 3, “Piping Installation” Article for foundation subdrainage work.

F. Add drainage course to width of at least 6 inches on sides away wall and to top of pipe to perform tests.

G. After satisfactory testing, cover drainage piping to width of at least 6 inches on side away from footing and above of pipe to within 12 inches of finish grade.

H. Install drainage course and wrap top of drainage course with flat-style geotextile filter fabric.

I. Place layer of flat geotextile filter fabric over top of drainage course, overlapping edges at least 4 inches.

J. Install drainage panels on foundation walls as follow:

1. Coordinate placement with other drainage materials.
2. Lay perforated drainage pipe at base of footing. Install as indicated in Part 3, “Piping Installation” Article.
3. Separate 4 inches of fabric at beginning of roll and cut away 4 inches of core. Wrap fabric around end on remaining core.
4. Attach panels to wall beginning at subdrainage pipe. Place and secure molded-sheet drainage panels, with geotextile facing away from wall.

K. Place backfill material over compacted drainage course. Place material in loose-depth layers not exceeding 6 inches. Thoroughly compact each layer. Final backfill to finish elevations and slope away from building.

3.8 UNDERSLAB DRAINAGE INSTALLATION

A. Excavate for underslab drainage system after subgrade material has been compacted but before drainage course has been placed. Include horizontal distance of at least 6 inches between drainage pipe and trench walls. Grade bottom of trench excavations to required slope, and compact to firm, solid bed for drainage system.

B. Lay flat-style geotextile filter fabric in trench and overlap trench sides.

C. Place supporting layer of drainage course over compacted subgrade and geotextile filter fabric, to compacted depth of not less than 4 inches.

D. Encase pipe with sock-style geotextile filter fabric before installing pipe. Connect sock sections with adhesive or tape.

E. Install drainage piping as indicated in Part 3 "Piping Installation" Article for underslab subdrainage.

F. Add drainage course to width of at least 6 inches on side away from wall and to top of pipe to perform tests.

G. After satisfactory testing, cover drainage piping with drainage course to elevation of bottom of slab, and compact and wrap top of drainage course with flat-style geotextile filter fabric.

H. Install horizontal drainage panels as follows:

1. Coordinate placement with other drainage materials.
2. Lay perforated drainage pipe at inside edge of footing.
3. Place drainage panel over drainage pipe with core side up. Peel back fabric and wrap fabric around pipe. Locate top of core at bottom elevation of floor slab.
4. Butt additional panels against other installed panels. If panels have plastic flanges, overlap installed panel with flange.

3.9 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect interior storm drainage piping to exterior storm drainage piping. Use transition fitting to join dissimilar piping materials.

C. Connect storm drainage piping to roof drains and storm drainage specialties.

1. Install test tees (wall cleanouts) in conductors near floor, and floor cleanouts with cover flush with floor.
2. Install horizontal backwater valves with cleanout cover flush with floor or in pit with pit cover flush with floor.
3. Comply with requirements for backwater valves, cleanouts and drains specified in Section 22 14 23 "Storm Drainage Piping Specialties."

D. Connect force-main piping to the following:

1. Sump Pumps: To sump pump discharge.

E. Where installing piping adjacent to equipment, allow space for service and maintenance.

F. Make connections according to the following unless otherwise indicated:

1. Install unions, in piping NPS 3 and smaller, adjacent to each valve and at final connection to each piece of equipment.

3.10 IDENTIFICATION

A. Identify exposed storm drainage piping.

B. Comply with requirements for identification specified in Section 22 05 53 "Identification for Plumbing Piping and Equipment."

3.11 FIELD QUALITY CONTROL

A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.

1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in.
2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

B. Test storm drainage piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:

1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired.

    a. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.

2. Leave uncovered and unconcealed new, altered, extended, or replaced storm drainage piping until it has been tested and approved.

    a. Expose work that was covered or concealed before it was tested.

3. Test Procedure:

    a. Test storm drainage piping, except outside leaders,] on completion of roughing-in.
    b. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water. From 15 minutes before inspection starts until completion of inspection, water level must not drop. Inspect joints for leaks.

4. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
5. Prepare reports for tests and required corrective action.

C. Test force-main piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:

1. Leave uncovered and unconcealed new, altered, extended, or replaced force-main piping until it has been tested and approved.

    a. Expose work that was covered or concealed before it was tested.

2. Cap and subject piping to static-water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials.

    a. Isolate test source and allow to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.

3. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
4. Prepare reports for tests and required corrective action.

D. Piping will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

3.12 TELEVISION INSPECTION

A. The contractor shall video inspect all sections of lines below the first-floor slab. Video inspection shall not be done until the pipe is laid and has passed the required leakage test.

B. Preparation for Video Inspection: Just prior to performing the video inspection, water will be to ensure that any area where ponding is possible will be filled with water.

C. Video Camera and Video Tape Equipment:

1. The video cameras and video cassette's recorder shall record in color. Lighting and camera quality shall be suitable to allow a clear, in-focus picture for the entire inside periphery of pipelines. The replay of the recorded video information shall be free of electrical interference and shall provide a clear stable image.
2. The videotaping and monitoring equipment shall have the capability to instantly review video quality of the video tape production at all times, with still picture reproduction also available. The video shall be furnished by the contractor and shall become the property of the University.

D. Operations:

1. The operating technician shall have control of the movement of the television camera at all times. The travel speed of the camera shall be variable but uniform, and shall not exceed 45 feet per minute while viewing. Any means of propelling the camera through the sewer lines which would produce nonuniform or jerky movements will not be acceptable. As directed by the University Inspector, the camera shall be stopped to view and analyze conditions that appear unusual or uncommon. The operating technicians shall at all times be able to move the camera through the lines in either direction without the loss of quality in the video presentation on the monitor.
2. Footage shall appear on the screen as well as the picture of the interior of the pipe and shall become a part of the video cassette record.

E. Inspection Records:

1. In addition to the video, a certified inspection report detailing the physical condition of each of the sewer mains scheduled for inspection shall be submitted to the University. Each main shall be reported individually providing the following information:

    a. The log shall contain the project name, inspector's name, date of inspection, client's name, pipe size, type of pipe, and tape footage reference number.
    b. The direction of flow and the direction of the camera shall be indicated as well as the section length.

F. Acceptance:

1. Any of the following observations shall be considered defects that will require corrections prior to acceptance.

    a. Ponding greater than 10 percent of the nominal pipe inside diameter or over 25 feet in length will be cause for rejection of the pipe segment.
    b. Joint separations - over 3/4 inch (18 mm).
    c. Offset joints.
    d. Chips in pipe ends - none more than 1/4 inch (6 mm) deep;
    e. Cracked or damaged pipe or evidence of the presence of an external object bearing upon the pipe (rocks, roots, etc.).
    f. Infiltration.
    g. Debris or other foreign objects.
    h. Other obvious deficiencies when compared to Approved Plans and Specifications and Standard Drawings.

i. The contractor shall be notified in writing of and deficiencies revealed by the television inspection that will require repair, following which the contractor shall excavate and make the necessary repairs and request a television re-inspection. Television re-inspection shall be at the contractor's expense.

3.13 CLEANING AND PROTECTION

A. Clean interior of piping. Remove dirt and debris as work progresses.

B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

C. Place plugs in ends of uncompleted piping at end of day and when work stops.

3.14 PIPING SCHEDULE

A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.

B. Aboveground storm drainage piping NPS 6 and smaller shall be the following:
1. Hubless, cast-iron soil pipe and fittings; CISPI, heavy-duty, hubless-piping couplings; and coupled joints.

C. Aboveground, storm drainage piping NPS 8 and larger shall be the following:

1. Hubless, cast-iron soil pipe and fittings; CISPI, heavy-duty, hubless-piping couplings; and coupled joints.

D. Underground storm drainage piping NPS 6 and smaller shall be any of the following:

1. Extra Heavy class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
2. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.

E. Underground, storm drainage piping NPS 8 and larger shall be any of the following:

1. Extra Heavy class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
2. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.

F. Aboveground storm drainage force mains NPS 3 and smaller shall be any of the following:

1. Hard copper tube, Type L copper pressure fittings, and soldered joints.
2. Galvanized-steel pipe, pressure fittings, and threaded joints.

END OF SECTION

SECTION 22 14 23 - STORM DRAINAGE PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Metal roof drains.
2. Miscellaneous storm drainage piping specialties.
3. Cleanouts.
4. Backwater valves.

B. Related Requirements:

1. Section 07 62 00 "Sheet Metal Flashing and Trim" for penetrations of roofs.
2. Section 07 84 13 "Penetration Firestopping" for firestopping roof penetrations.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.4 QUALITY ASSURANCE

A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

PART 2 - PRODUCTS

2.1 METAL ROOF DRAINS

A. Cast-Iron, Medium-Sump, General-Purpose Roof Drains:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Jay R. Smith Mfg. Co.
b. Josam Company.
c. MIFAB, Inc.
d. WATTS.
e. ZURN Industries.

2. Standard: ASME A112.6.4.
3. Body Material: Cast iron.
4. Dimension of Body: Nominal 14-to 16-inch diameter.
5. Combination Flashing Ring and Gravel Stop: Required.
6. Flow-Control Weirs: Not required.
7. Outlet: Bottom.
8. Outlet Type: No hub.

9. Extension Collars: Required.
10. Underdeck Clamp: Required.
11. Expansion Joint: Not required.
12. Sump Receiver Plate: Not required.
13. Dome Material: Cast iron.
14. Perforated Gravel Guard: Stainless steel.
15. Vandal-Proof Dome: Required.
16. Water Dam: 2 inches high. (Secondary drains only.)

2.2 MISCELLANEOUS STORM DRAINAGE PIPING SPECIALTIES

A. Downspout Covers:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

    a. Jay R. Smith Mfg. Co.
    b. Josam Company.
    c. Zurn Industries.

2. Round fabricated stainless steel frame with secured perforated stainless-steel hinged strainer.

    a. Provide finish selection options for architect’s approval.

2.3 CLEANOUTS

A. Cast-Iron Exposed Cleanouts:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Jay R. Smith Mfg. Co.
    b. Josam Company.
    c. MIFAB, Inc.
    d. Tyler Pipe; a subsidiary of McWane Inc.
    e. WATTS.
    f. ZURN Industries.

2. Standard: ASME A112.36.2M.
3. Size: Same as connected branch.
4. Body Material: No-hub, cast-iron soil pipe test tee as required to match connected piping.
5. Closure: Countersunk or raised-head plug.
6. Closure Plug Size: Same as, or not more than, one size smaller than cleanout size.

B. Cast-Iron Exposed Floor Cleanouts:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Jay R. Smith Mfg. Co.
    b. Josam Company.
    c. MIFAB, Inc.
    d. Tyler Pipe; a subsidiary of McWane Inc.
    e. WATTS.

f. ZURN Industries.

2. Standard: ASME A112.36.2M.
3. Size: Same as connected branch.
4. Type: Threaded, adjustable housing.
5. Body or Ferrule: Cast iron.
6. Clamping Device: Required.
7. Outlet Connection: No hub.
8. Closure: Cast-iron plug.
9. Adjustable Housing Material: Cast iron with threads, setscrews or other device.
10. Frame and Cover Material and Finish: Nickel-bronze, copper alloy.
11. Frame and Cover Shape: Round.
12. Top Loading Classification: Heavy Duty.
13. Riser: ASTM A74, Extra-Heavy class, cast-iron drainage pipe fitting and riser to cleanout.

C. Cast-Iron Wall Cleanouts:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Jay R. Smith Mfg. Co.
b. Josam Company.
c. MIFAB, Inc.
d. Tyler Pipe; a subsidiary of McWane Inc.
e. WATTS.
f. ZURN Industries.

2. Standard: ASME A112.36.2M. Include wall access.
3. Size: Same as connected drainage piping.
4. Body: No-hub, cast-iron soil pipe test tee as required to match connected piping.
5. Closure Plug:

a. Cast iron.
b. Countersunk head.
c. Drilled and threaded for cover attachment screw.
d. Size: Same as, or not more than, one size smaller than cleanout size.

6. Wall Access: Round, nickel-bronze, copper-alloy, or stainless-steel wall-installation frame and cover.

D. Test Tees:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Jay R. Smith Mfg. Co.
b. Josam Company.
c. MIFAB, Inc.
d. Tyler Pipe; a subsidiary of McWane Inc.
e. WATTS.
f. ZURN Industries.

2. Standard: ASME A112.36.2M and ASTM A74, ASTM A888, or CISPI 301.
3. Size: Same as connected drainage piping.

4. Body Material: Hub-and-spigot, cast-iron soil-pipe T-branch or no-hub, cast-iron soil-pipe test tee as required to match connected piping.
5. Closure Plug: Countersunk, brass.
6. Closure Plug Size: Same as, or not more than, one size smaller than cleanout size.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install roof drains at low points of roof areas according to roof membrane manufacturer's written installation instructions.

1. Install flashing collar or flange of roof drain to prevent leakage between drain and adjoining roofing. Maintain integrity of waterproof membranes where penetrated.
2. Install expansion joints, if indicated, in roof drain outlets.
3. Position roof drains for easy access and maintenance.

B. Install downspout adapters on outlet of back-outlet parapet roof drains and connect to sheet metal downspouts.

C. Install downspout boots at grade with top 12 inches above grade. Secure to building wall.

D. Install conductor nozzles at exposed bottom of conductors where they spill onto grade.

E. Install cleanouts in aboveground piping and building drain piping according to the following instructions unless otherwise indicated:

1. Use cleanouts the same size as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
2. Locate cleanouts at each change in direction of piping greater than 45 degrees.
3. Locate cleanouts at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
4. Locate cleanouts at base of each vertical storm piping conductor.

F. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.

G. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.

H. Install horizontal backwater valves in floor with cover flush with floor.

I. Install drain-outlet backwater valves in outlet of drains.

J. Install test tees in vertical conductors and near floor.

K. Install wall cleanouts in vertical conductors. Install access door in wall if indicated.

L. Install trench drains at low points of surface areas to be drained. Set grates of drains flush with finished surface unless otherwise indicated.

M. Assemble channel drainage system components according to manufacturer's written instructions. Install on support devices so that top will be flush with adjacent surface.

N. Install through-penetration firestop assemblies for penetrations of fire- and smoke-rated assemblies.

1. Comply with requirements in Section 07 84 13 "Penetration Firestopping."

3.2 CONNECTIONS

A. Comply with requirements for piping specified in Section 22 14 13 "Facility Storm Drainage Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

3.3 FLASHING INSTALLATION

A. Fabricate flashing from single piece of metal unless large pans, sumps, or other drainage shapes are required.

B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.

C. Set flashing on floors and roofs in solid coating of bituminous cement.

D. Secure flashing into sleeve and specialty clamping ring or device.

3.4 PROTECTION

A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.

B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION

THIS PAGE IS LEFT INTENTIONALLY BLANK.

SECTION 22 14 29 - SUMP PUMPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Packaged drainage-pump units.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings:

1. Include plans, elevations, sections, and [mounting] [attachment] details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power, signal, and control wiring.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For pumps and controls, to include in operation and maintenance manuals.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Retain shipping flange protective covers and protective coatings during storage.

B. Protect bearings and couplings against damage.

C. Comply with manufacturer's written instructions for handling.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. UL Compliance: Comply with UL 778 for motor-operated water pumps.

2.2 PACKAGED DRAINAGE-PUMP OIL-MISER UNITS

A. Packaged Submersible Drainage-Pump Units:

1. Description: Factory-assembled and -tested, automatic-operation, freestanding, sump-pump unit.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Liberty Pump Company.
    b. Stancor Pumps, Inc.
    c. Zoeller Pump Comp

3. Pump Type: Submersible, factory assembled and tested, automatic-operation, basin-mounted, oil-miser unit.
4. Casing: Metal.
5. Impeller: Brass.
6. Pump Seal: Mechanical.
7. Enclosure: NEMA 4x weathertight corrosion resistant fiberglass.
8. Motor: Hermetically sealed, capacitor-start type, with built-in overload protection.
9. Power Cord: Three-conductor, waterproof cable of length required, but not less than 72 inches, with grounding plug and cable-sealing assembly for connection at pump.
10. Pump Discharge Piping: Factory or field fabricated, galvanized, ASTM A 53/A 53M, Schedule 40, steel pipe with ASME B16.4, Class 125, gray-iron threaded fittings.
11. Control: Motor-mounted float switch. Local and remote audio and visual warning systems for (a) hydraulic oil spill alert (b) high liquid condition, and (c) high amperage. Provide with remote monitoring circuit.
12. Comply with ASME A17.1.
13. Stainless steel sensor probe.
14. All pump and control cables shall be factory wired into a wall mountable junction box. Between the junction box and the main control panel shall be a multi-pin quick connect cable.
15. Basin: Not required.

B. Capacities and Characteristics:

1. Capacity: See Equipment Schedules.

2.3 MOTORS

A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 22 05 13 "Common Motor Requirements for Plumbing Equipment."

1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.

B. Motors for submersible pumps shall be hermetically sealed.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for plumbing piping to verify actual locations of storm drainage piping connections before sump pump installation.

3.2 INSTALLATION

A. Pump Installation Standards: Comply with HI 1.4 for installation of sump pumps.

B. Wiring Method: Comply with requirements in Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."

C. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.

3.3 CONNECTIONS

A. Comply with requirements for piping specified in Section 22 14 13 "Facility Storm Drainage Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

B. Where installing piping adjacent to equipment, allow space for service and maintenance.

3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test, inspect, and adjust components, assemblies, and equipment installations, including connections.

B. Perform the following tests and inspections:

1. Perform each visual and mechanical inspection.
2. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Pumps and controls will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

3.5 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.

3.6 ADJUSTING

A. Adjust pumps to function smoothly, and lubricate as recommended by manufacturer.

B. Adjust control set points.

3.7 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain controls and pumps.

END OF SECTION

SECTION 22 32 00 - DOMESTIC WATER FILTRATION EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Off-floor cartridge filters.

B. Related Sections:

1. Section 22 11 19 "Domestic Water Piping Specialties" for plumbing piping strainers.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for filters and separators. Include rated capacities, operating characteristics, and furnished specialties and accessories.

B. Shop Drawings: For water filtration equipment. Include plans, elevations, sections, details, and attachments to other work.

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1.4 INFORMATIONAL SUBMITTALS

A. Certificates of Shop Inspections and Data Reports: For products required to have ASME label, signed by product manufacturer.

B. Source quality-control reports.

C. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For water filtration equipment to include in emergency, operation, and maintenance manuals.

1.6 MATERIALS MAINTENANCE SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Cartridge-Filter Elements: Elements for cartridge filters equal to 200 percent of amount installed for each size and media indicated.

1.7 QUALITY ASSURANCE

A. Source Limitations: Obtain each type of water filtration equipment through one source from a single manufacturer.

B. Comply with NSF 61 Annex, "Drinking Water System Components - Health Effects," for all components that will be in contact with potable water.

1.8 COORDINATION

A. Coordinate size and location of concrete bases with actual equipment provided.

PART 2 - PRODUCTS

2.1 CARTRIDGE FILTERS

A. Off-Floor Cartridge Filters:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Culligan International Company.
b. Everpure, LLC.
c. Filtrine Manufacturing Company.
d. Parker Hannifin Corp.
e. Pentair Filtration, Inc.
f. Siemens AG Water Technologies.

2. Description: Simplex, in-line or wall-mounted housing with replaceable element for removing suspended particles from water.

a. Housing: Corrosion resistant; designed to separate feedwater from filtrate and to direct feedwater through water filter element; with element support.

1) Pipe Connections: Threaded according to ASME B1.20.1.
2) Support: Wall bracket.

b. Element: Replaceable; of shape to fit housing.

3. Capacity and Characteristics:

a. Filter Design:

1) Filtration Efficiency: 98 percent retention of suspended particles 20 micrometers and larger from feedwater of listed filtrate design concentrations.
2) Pressure Drop: Not to exceed 2 psig at filter design flow rate when clean and 5 psig when dirty.

b. Housing:

1) Material: PE or PP.

2) Pressure Rating: 125 psig.
3) Seals: NBR.

c. Element:

1) Media: Pleated polyester or pleated PP.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of filters.

B. Examine roughing-in for piping systems to verify actual locations of piping connections before equipment installation.

C. Examine walls and floors for suitable conditions where filters will be installed.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 CARTRIDGE-FILTER INSTALLATION

A. Install cartridge filters level and plumb, according to layout drawings, original design, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so devices needing service are accessible.

B. Attach wall brackets for off-floor, wall-mounted, cartridge filter to vertical surface. Attach housing(s), and base if any, to wall bracket.

C. Install housings for off-floor, in-line, cartridge filters in piping.

D. Install filter elements in cartridges.

3.3 CONNECTIONS

A. Comply with requirements for piping specified in Section 22 11 16 "Domestic Water Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment to allow service and maintenance.

C. Make piping connections between water filtration equipment and dissimilar-metal water piping with dielectric fittings. Comply with requirements for dielectric fittings specified in Section 22 11 16 "Domestic Water Piping."

D. Install shutoff valves on feedwater-inlet and filtrate-outlet piping of each water filtration equipment.

1. Comply with requirements for metal general-duty valves specified in Section 22 05 23.12 "Ball Valves for Plumbing Piping."

3.4 IDENTIFICATION

A. Identify system components. Comply with requirements for identification specified in Section 22 05 53 "Identification for Plumbing Piping and Equipment."

3.5 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

B. Tests and Inspections:

1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
2. Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation.
3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Domestic water filtration equipment will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

END OF SECTION

SECTION 22 33 00 - ELECTRIC, DOMESTIC-WATER HEATERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Commercial, electric, storage, domestic-water heaters.
2. Domestic-water heater accessories.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Sustainable Design Submittals:

1. Product Data: For energy efficiency.

C. Shop Drawings:

1. Include diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Equipment room drawing or BIM model, drawn to scale, on which the items described in this Section are shown and coordinated with all building trades.

B. Product Certificates: For each type of commercial, electric, domestic-water heater.

C. Domestic-Water Heater Labeling: Certified and labeled by testing agency acceptable to authorities having jurisdiction.

D. Source quality-control reports.

E. Field quality-control reports.

F. Sample Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For electric, domestic-water heaters to include emergency, operation, and maintenance manuals.

1.6 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided.

1.7 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of electric, domestic-water heaters that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures including storage tank and supports.
b. Faulty operation of controls.
c. Deterioration of metals, metal finishes, and other materials beyond normal use.

2. Warranty Periods: Two (2) years from date of Substantial Completion, except as noted.

a. Commercial, Electric, Storage, Domestic-Water Heaters:

1) Storage Tank: Five years.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and use.

B. ASHRAE/IES Compliance: Applicable requirements in ASHRAE/IES 90.1.

C. NSF Compliance: Fabricate and label equipment components that will be in contact with potable water to comply with NSF 61 and NSF 372.

2.2 COMMERCIAL, ELECTRIC, DOMESTIC-WATER HEATERS

A. Commercial, Electric, Storage, Domestic-Water Heaters:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. A. O. Smith Corporation.
b. Lochinvar, LLC.
c. PVI; A WATTS Brand.

2. Source Limitations: Obtain domestic-water heaters from single source from single manufacturer.
3. Standard: UL 1453.
4. Storage-Tank Construction: ASME-code, steel vertical arrangement.

a. Tappings: Factory fabricated of materials compatible with tank and piping connections. Attach tappings to tank before testing.

1) NPS 2 and Smaller: Threaded ends in accordance with ASME B1.20.1.

2) NPS 2-1/2 and Larger: Flanged ends in accordance with ASME B16.5 for steel and stainless steel flanges, and in accordance with ASME B16.24 for copper and copper-alloy flanges.

b. Pressure Rating: 150 psig.
c. Interior Finish: Comply with NSF 61 and NSF 372 barrier materials for potable-water tank linings, including extending lining material into tappings.

5. Factory-Installed, Storage-Tank Appurtenances:

a. Anode Rod: Replaceable magnesium.
b. Drain Valve: Corrosion-resistant metal with hose-end connection.
c. Insulation: Comply with ASHRAE/IES 90.1.
d. Jacket: Steel with enameled finish or high-impact composite material.
e. Heating Elements: Electric, screw-in or bolt-on immersion type arranged in multiples of three.
f. Temperature Control: Adjustable thermostat.
g. Safety Controls: High-temperature-limit and low-water cutoff devices or systems.
h. Relief Valves: ASME rated and stamped for combination temperature-and-pressure relief valves. Include one or more relief valves with total relieving capacity at least as great as heat input, and include pressure setting less than working-pressure rating of domestic-water heater. Select one relief valve with sensing element that extends into storage tank.

6. Special Requirements: NSF 5 construction.
7. Capacity and Characteristics:

a. See Equipment Schedules.

2.3 DOMESTIC-WATER HEATER ACCESSORIES

A. Domestic-Water Expansion Tanks:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. A. O. Smith Corporation.
b. AMTROL, Inc.
c. Taco Comfort Solutions.

2. Source Limitations: Obtain domestic-water expansion tanks from single source from single manufacturer.
3. Description: Steel pressure-rated tank constructed with welded joints and factory-installed, butyl-rubber diaphragm. Include air precharge to minimum system-operating pressure at tank.
4. Construction:

a. Tappings: Factory-fabricated steel, welded to tank before testing and labeling. Include ASME B1.20.1 pipe thread.
b. Interior Finish: Comply with NSF 61 and NSF 372 barrier materials for potable-water tank linings, including extending finish into and through tank fittings and outlets.
c. Air-Charging Valve: Factory installed.

5. Capacity and Characteristics:

a. See Equipment Schedules.

B. Drain Pans: Corrosion-resistant metal with raised edge. Include dimensions not less than base of domestic-water heater, and include drain outlet not less than NPS 3/4 with ASME B1.20.1 pipe threads.

C. Piping-Type Heat Traps: Field-fabricated piping arrangement in accordance with ASHRAE/IES 90.1.

D. Manifold Kits: Domestic-water-heater manufacturer's factory-fabricated inlet and outlet piping for field installation, for multiple domestic-water heater installation. Include ball-, butterfly-, or gate-type shutoff valves to isolate each domestic-water heater and [**calibrated**] [**memory-stop**] balancing valves to provide balanced flow through each domestic-water heater.

1. Comply with requirements for ball-, butterfly-, or gate-type shutoff valves specified in Section 220523.12 "Ball Valves for Plumbing Piping," Section 220523.13 "Butterfly Valves for Plumbing Piping," and Section 220523.15 "Gate Valves for Plumbing Piping."
2. Comply with requirements for balancing valves specified in Section 221119 "Domestic Water Piping Specialties."

E. Combination Temperature-and-Pressure Relief Valves: ASME rated and stamped. Include relieving capacity at least as great as heat input, and include pressure setting less than working-pressure rating of domestic-water heater. Select relief valves with sensing element that extends into storage tank.

F. Shock Absorbers: ASSE 1010 or PDI-WH 201, Size A water hammer arrester.

G. Domestic-Water Heater Stands: Manufacturer's factory-fabricated steel stand for floor mounting, capable of supporting domestic-water heater and water. Include dimension that will support bottom of domestic-water heater a minimum of 18 inches above the floor.

H. Domestic-Water Heater Mounting Brackets: Manufacturer's factory-fabricated steel bracket for wall mounting, capable of supporting domestic-water heater and water.

2.4 SOURCE QUALITY CONTROL

A. Factory Tests: Test and inspect domestic-water heaters specified to be ASME-code construction, in accordance with ASME Boiler and Pressure Vessel Code

B. Hydrostatically test commercial domestic-water heaters to minimum of one and one-half times pressure rating before shipment.

C. Electric, domestic-water heaters will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 DOMESTIC-WATER HEATER INSTALLATION

A. Install electric, domestic-water heaters level and plumb, in accordance with layout drawings, original design, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.

B. Install commercial, electric, domestic-water heaters on concrete base. Comply with requirements for concrete bases specified in Section 033000 "Cast-in-Place Concrete."

1. Exception: Omit concrete bases for commercial, electric, domestic-water heaters if installation on stand, bracket, suspended platform, or directly on floor is indicated.
2. Maintain manufacturer's recommended clearances.
3. Arrange units so controls and devices that require servicing are accessible.
4. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
5. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
6. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
7. Install anchor bolts to elevations required for proper attachment to supported equipment.
8. Anchor domestic-water heaters to substrate.
9. Install shutoff valves on domestic-water-supply piping to domestic-water heaters and on domestic-hot-water outlet piping. Comply with requirements for shutoff valves specified in Section 22 05 23.12 "Ball Valves for Plumbing Piping."

C. Install dielectric fittings in all locations where piping of dissimilar metals is to be joined. The wetted surface of the dielectric fitting contacted by potable water shall contain less than 0.25 percent of lead by weight.

D. Install combination temperature-and-pressure relief valves in top portion of storage tanks. Use relief valves with sensing elements that extend into tanks. Extend domestic-water heater relief-valve outlet, with drain piping same as domestic-water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.

E. Install combination temperature-and-pressure relief valves in water piping for electric, domestic-water heaters without storage. Extend domestic-water heater relief-valve outlet, with drain piping same as domestic-water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.

F. Install water-heater drain piping as indirect waste to spill by positive air gap into open drains or over floor drains. Install hose-end drain valves at low points in water piping for electric, domestic-water heaters that do not have tank drains. Comply with requirements for hose-end drain valves specified in Section 221119 "Domestic Water Piping Specialties."

G. Install thermometers on outlet piping of electric, domestic-water heaters. Comply with requirements for thermometers specified in Section 220519 "Meters and Gages for Plumbing Piping."

H. Assemble and install inlet and outlet piping manifold kits for multiple electric, domestic-water heaters. Fabricate, modify, or arrange manifolds for balanced water flow through each electric, domestic-water heater. Include shutoff valve and thermometer in each domestic-water heater inlet and outlet, and throttling valve in each electric, domestic-water heater outlet. Comply with requirements for valves specified in Section 220523.12 "Ball Valves for Plumbing Piping," Section 220523.13 "Butterfly Valves for Plumbing Piping," and comply with requirements for thermometers specified in Section 220519 "Meters and Gages for Plumbing Piping."

I. Install piping-type heat traps on inlet and outlet piping of electric, domestic-water heater storage tanks without integral or fitting-type heat traps.

J. Fill electric, domestic-water heaters with water.

K. Charge domestic-water expansion tanks with air to required system pressure.

L. Install dielectric fittings in all locations where piping of dissimilar metals is to be joined. The wetted surface of the dielectric fitting contacted by potable water shall contain less than 0.25 percent of lead by weight.

3.2 PIPING CONNECTIONS

A. Comply with requirements for piping specified in Section 22 11 16 "Domestic Water Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

B. Where installing piping adjacent to electric, domestic-water heaters, allow space for service and maintenance of water heaters. Arrange piping for easy removal of domestic-water heaters.

3.3 IDENTIFICATION

A. Identify system components. Comply with requirements for identification specified in Section 22 05 53 "Identification for Plumbing Piping and Equipment."

3.4 FIELD QUALITY CONTROL

A. Perform tests and inspections with the assistance of a factory-authorized service representative.

B. Tests and Inspections:

1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
2. Operational Test: After electrical circuitry has been energized, start units to confirm proper operation.
3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Electric, domestic-water heaters will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain electric, domestic-water heaters. Training shall be a minimum of one hour.

END OF SECTION

SECTION 22 42 13.13 - COMMERCIAL WATER CLOSETS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Water closets.
2. Flushometer valves and tanks.
3. Toilet seats.
4. Supports.

1.3 DEFINITIONS

A. Effective Flush Volume: Average of two reduced flushes and one full flush per fixture.

B. Standard-Efficiency Flush Volume: 1.6 gal. per flush.

C. High-Efficiency Flush Volume: 1.28 gal. or less per flush.

D. WaterSense Fixture: Water closet and/or flushometer valve/tank certified by the EPA to meet the WaterSense performance criteria.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for water closets.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Sustainable Design Submittals:

1. Product Data: For water consumption.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For flushometer valves to include in operation and maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that are packaged with protective covering for storage and identified with labels describing contents.

1. Flushometer-Valve Repair Kits: Equal to 10 percent of amount of each type installed, but no fewer than two of each type.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Standards:

1. Comply with ASME A112.19.2/CSA B45.1 for water closets.
2. Comply with ASSE 1037/ASME A112.1037/CSA B125.37 for flush valves.
3. Comply with IAMPO/ANSI Z124.5 for water-closet (toilet) seats.
4. Comply with ASME A112.6.1M for water-closet supports.
5. Comply with ICC A117.1 for ADA-compliant water closets.

2.2 FLOOR MOUNTED WATER CLOSETS - TANK

A. Water Closets - Floor Mounted, Bottom Outlet, Close-Coupled Flushometer Tank.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. American Standard.
b. Kohler Co.
c. Sloan.
d. TOTO USA, Inc.
e. Zurn Industries, LLC.

2. Source Limitations: Obtain water closets from single source from single manufacturer.
3. Bowl:

a. Material: Vitreous china.
b. Type: One piece.
c. Style: Flushometer tank.
d. Height: ADA compliant.
e. Rim Contour: Elongated.
f. Water Consumption: 1.28 gal. per flush.
g. Color: White.

2.3 WALL-MOUNTED WATER CLOSETS -SINGLE FLUSH

A. Water Closets: Wall mounted, top spud, accessible.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. American Standard.
b. Crane Plumbing, LLC.
c. Kohler Co.
d. Sloan Valve Company.
e. TOTO USA, INC.

2. Bowl:

a. Standards: ASME A112.19.2/CSA B45.1 and ASME A112.19.5.
b. Material: Vitreous china.
c. Type: Siphon jet.
d. Style: Flushometer valve.
e. Height: Standard.
f. Rim Contour: Elongated.
g. Water Consumption: 1.28 gal.
h. Spud Size and Location: NPS 1-1/2; top.

3. Flushometer Valve: Required.
4. Toilet Seat: Required.
5. Support: Water closet carrier.
6. Water-Closet Mounting Height: Standard and Handicapped/elderly according to ICC/ANSI A117.

2.4 WALL-MOUNTED WATER CLOSETS – DUAL FLUSH

A. Water Closets: Wall mounted, top spud, accessible.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. American Standard.
b. Crane Plumbing, LLC.
c. Kohler Co.
d. Sloan Valve Company.
e. TOTO USA, INC.

2. Bowl:

a. Standards: ASME A112.19.2/CSA B45.1 and ASME A112.19.5.
b. Material: Vitreous china.
c. Type: Siphon jet.
d. Style: Flushometer valve.
e. Height: Standard.
f. Rim Contour: Elongated.
g. Water Consumption: 1.28/1.10 gal. – dual flush.
h. Spud Size and Location: NPS 1-1/2; top.

3. Flushometer Valve: Required.
4. Toilet Seat: Required.
5. Support: Water closet carrier.
6. Water-Closet Mounting Height: Standard and Handicapped/elderly according to ICC/ANSI A117.1.

2.5 FLUSHOMETER VALVES

A. Flushometer Valves – Diaphragm, Sensor Operated, Battery Powered: Single Flush

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. American Standard.
b. Gerber Plumbing Fixtures LLC.
c. Sloan Valve Company.

d. TOTO USA, INC.

2. Source Limitations: Obtain flushometer valve from single source from single manufacturer.
3. Minimum Pressure Rating: 125 psig.
4. Features: Include integral check stop and backflow-prevention device.
5. Material: Brass body with corrosion-resistant components.
6. Style: Exposed.
7. Exposed Flushometer-Valve Finish: Chrome-plated.
8. Panel Finish: Chrome-plated or stainless steel.
9. Trip Mechanism: Battery-powered electronic sensor; listed and labeled as defined in NFPA 70, by qualified testing agency, and marked for intended location and application.
10. Consumption: 1.28 gal. per flush.
11. Minimum Inlet: NPS 1.
12. Minimum Outlet: NPS 1-1/4.

B. Flushometer Valves – Diaphragm, Sensor Operated, Battery Powered: Dual Flush

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. American Standard.
b. Gerber Plumbing Fixtures LLC.
c. Sloan Valve Company.
d. TOTO USA, INC.

2. Source Limitations: Obtain flushometer valve from single source from single manufacturer.
3. Minimum Pressure Rating: 125 psig.
4. Features: Include integral check stop and backflow-prevention device.
5. Material: Brass body with corrosion-resistant components.
6. Style: Exposed.
7. Exposed Flushometer-Valve Finish: Chrome-plated.
8. Panel Finish: Chrome-plated or stainless steel.
9. Trip Mechanism: Battery-powered electronic sensor; listed and labeled as defined in NFPA 70, by qualified testing agency, and marked for intended location and application.
10. Consumption: Dual flush 1.1 gal. /1.28 gal. per flush.
11. Minimum Inlet: NPS 1.
12. Minimum Outlet: NPS 1-1/4.

2.6 TOILET SEATS

A. Toilet Seats for Wall Mounted Water Closets:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Bemis Manufacturing Company.
b. Church Seats; Bemis Manufacturing Company.
c. Kohler Co.
d. TOTO.

2. Standard: IAPMO/ANSI Z124.5.

3. Material: Plastic.
4. Type: Commercial (Heavy duty).
5. Shape: Elongated rim, open front.
6. Hinge: Check.
7. Hinge Material: Noncorroding metal.
8. Seat Cover: Not required.
9. Color: White.

B. Toilet Seats for Floor Mounted Water Closets:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Bemis Manufacturing Company.
   b. Church Seats; Bemis Manufacturing Company.
   c. Kohler Co.
   d. TOTO.

2. Standard: IAPMO/ANSI Z124.5.
3. Material: Plastic.
4. Type: Commercial (Heavy duty).
5. Shape: Elongated rim, open front.
6. Hinge: Check.
7. Hinge Material: Noncorroding metal.
8. Seat Cover: Required.
9. Color: White.

2.7 SUPPORTS

A. Water Closet Carrier:

1. Standard: ASME A112.6.1M.
2. Description: Waste-fitting assembly, as required to match drainage piping material and arrangement with faceplates, couplings gaskets, and feet; bolts and hardware matching fixture. Include additional extension coupling, faceplate, and feet for installation in wide pipe space.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before water-closet installation.

B. Examine walls and floors for suitable conditions where water closets will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Water-Closet Installation:

1. Install level and plumb according to roughing-in drawings.

2. Install floor-mounted water closets on bowl-to-drain connecting fitting attachments to piping or building substrate.
3. Install accessible, wall-mounted water closets at mounting height for handicapped/elderly, according to ICC/ANSI A117.1.

B. Support Installation:

1. Install supports, affixed to building substrate, for floor-mounted, back-outlet water closets.
2. Use carrier supports with waste-fitting assembly and seal.
3. Install wall-mounted, back-outlet water-closet supports with waste-fitting assembly and waste-fitting seals; and affix to building substrate.

C. Flushometer-Valve Installation:

1. Install flushometer-valve, water-supply fitting on each supply to each water closet.
2. Attach supply piping to supports or substrate within pipe spaces behind fixtures.
3. Install actuators in locations that are easy for people with disabilities to reach.
4. Install new batteries in battery-powered, electronic-sensor mechanisms.

D. Install toilet seats on water closets.

E. Wall Flange and Escutcheon Installation:

1. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations and within cabinets and millwork.
2. Install deep-pattern escutcheons if required to conceal protruding fittings.
3. Comply with escutcheon requirements specified in Section 22 05 18 "Escutcheons for Plumbing Piping."

F. Joint Sealing:

1. Seal joints between water closets and walls and floors using sanitary-type, one-part, mildew-resistant silicone sealant.
2. Match sealant color to water-closet color.
3. Comply with sealant requirements specified in Section 07 92 00 "Joint Sealants."

3.3 CONNECTIONS

A. Connect water closets with water supplies and soil, waste, and vent piping. Use size fittings required to match water closets.

B. Comply with water piping requirements specified in Section 22 11 16 "Domestic Water Piping."

C. Comply with soil and waste piping requirements specified in Section 22 13 16 "Sanitary Waste and Vent Piping."

D. Where installing piping adjacent to water closets, allow space for service and maintenance.

3.4 ADJUSTING

A. Operate and adjust water closets and controls. Replace damaged and malfunctioning water closets, fittings, and controls.

B. Adjust water pressure at flushometer valves to produce proper flow.

3.5 CLEANING AND PROTECTION

A. Clean water closets and fittings with manufacturers' recommended cleaning methods and materials.

B. Install protective covering for installed water closets and fittings.

C. Do not allow use of water closets for temporary facilities unless approved in writing by Owner.

END OF SECTION

THIS PAGE INTENTIONALLY LEFT BLANK.

SECTION 22 42 13.16 - COMMERCIAL URINALS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Urinals.
2. Flushometer valves.
3. Supports.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for urinals.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Sustainable Design Submittals:

1. Product Data: For water consumption.

C. Shop Drawings: Include diagrams for power, signal, and control wiring.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For flushometer valves and electronic sensors to include in operation and maintenance manuals.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that are packaged with protective covering for storage and identified with labels describing contents.

1. Flushometer-Valve Repair Kits: Equal to 10 percent of amount of each type installed, but no fewer than three of each type.

PART 2 - PRODUCTS

2.1 WALL-HUNG URINALS

A. Urinals: Wall hung, back outlet, washout, accessible.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. American Standard.

b. Crane Plumbing, L.L.C.
c. Kohler Co.
d. TOTO USA, INC.

2. Fixture:

a. Standards: ASME A112.19.2/CSA B45.1 and ASME A112.19.5.
b. Material: Vitreous china.
c. Type: Washout with extended shields.
d. Strainer or Trapway: Manufacturer's standard strainer with integral trap.
e. Water Consumption: Water saving.
f. Spud Size and Location: NPS 3/4, top.
g. Outlet Size and Location: NPS 2, back.
h. Color: White.

3. Flushometer Valve: Required.
4. Waste Fitting:

a. Standard: ASME A112.18.2/CSA B125.2 for coupling.
b. Size: NPS 2.

5. Support: Type I Urinal Carrier with fixture support plates and coupling with seal and fixture bolts and hardware matching fixture. Include rectangular, steel uprights.
6. Urinal Mounting Height: Standard and Handicapped/elderly according to ICC A117.1.

2.2 URINAL FLUSHOMETER VALVES

A. Battery-Powered, Solenoid-Actuator, Diaphragm Flushometer Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Gerber Plumbing Fixtures LLC.
b. Sloan Valve Company.
c. TOTO USA, INC.

2. Standard: ASSE 1037/ASME 112.1037/CSA B125.37.
3. Minimum Pressure Rating: 125 psig.
4. Features: Include integral check stop and backflow-prevention device.
5. Material: Brass body with corrosion-resistant components.
6. Exposed Flushometer-Valve Finish: Chrome plated.
7. Panel Finish: Chrome plated or stainless steel.
8. Style: Exposed.
9. Actuator: Solenoid complying with UL 1951; listed and labeled as defined in NFPA 70, by a qualified testing agency; and marked for intended location and application.
10. Trip Mechanism: Battery-powered electronic sensor complying with UL 1951; listed and labeled as defined in NFPA 70, by a qualified testing agency; and marked for intended location and application.
11. Consumption: 0.125 gal. per flush.
12. Minimum Inlet: NPS 3/4.
13. Minimum Outlet: NPS 3/4.

2.3 SUPPORTS

A. Type I Urinal Carrier:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Jay R. Smith Mfg. Co.
b. Josam Company.
c. MIFAB, Inc.
d. WATTS.

2. Standard: ASME A112.6.1M.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before urinal installation.

B. Examine walls and floors for suitable conditions where urinals will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Urinal Installation:

1. Install urinals level and plumb according to roughing-in drawings.
2. Install wall-hung, back-outlet urinals onto waste fitting seals and attached to supports.
3. Install accessible, wall-mounted urinals at mounting height for the handicapped/elderly, according to ICC/ANSI A117.1.

B. Support Installation:

1. Install supports, affixed to building substrate, for wall-hung urinals.
2. Use off-floor carriers with waste fitting and seal for back-outlet urinals.
3. Use chair-type carrier supports with rectangular steel uprights for accessible urinals.

C. Flushometer-Valve Installation:

1. Install flushometer-valve water-supply fitting on each supply to each urinal.
2. Attach supply piping to supports or substrate within pipe spaces behind fixtures.

D. Wall Flange and Escutcheon Installation:

1. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations.
2. Install deep-pattern escutcheons if required to conceal protruding fittings.
3. Comply with escutcheon requirements specified in Section 22 05 18 "Escutcheons for Plumbing Piping."

E. Joint Sealing:

1. Seal joints between urinals and walls and floors using sanitary-type, one-part, mildew-resistant silicone sealant.
2. Match sealant color to urinal color.
3. Comply with sealant requirements specified in Section 07 92 00 "Joint Sealants."

3.3 CONNECTIONS

A. Connect urinals with water supplies and soil, waste, and vent piping. Use size fittings required to match urinals.

B. Comply with water piping requirements specified in Section 22 11 16 "Domestic Water Piping."

C. Comply with soil and waste piping requirements specified in Section 22 13 16 "Sanitary Waste and Vent Piping."

D. Where installing piping adjacent to urinals, allow space for service and maintenance.

3.4 ADJUSTING

A. Operate and adjust urinals and controls. Replace damaged and malfunctioning urinals, fittings, and controls.

B. Adjust water pressure at flushometer valves to produce proper flow.

C. Install fresh batteries in battery-powered, electronic-sensor mechanisms.

3.5 CLEANING AND PROTECTION

A. Clean urinals and fittings with manufacturers' recommended cleaning methods and materials.

B. Install protective covering for installed urinals and fittings.

C. Do not allow use of urinals for temporary facilities unless approved in writing by Owner.

END OF SECTION

SECTION 22 42 16.13 - COMMERCIAL LAVATORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Lavatory systems.
2. Lavatories.
3. Faucets.
4. Supply fittings.
5. Waste fittings.
6. Supports.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for lavatories.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Sustainable Design Submittals:

1. Product Data: For water consumption.

C. Shop Drawings: Include diagrams for power, signal, and control wiring of automatic faucets.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Counter cutout templates for mounting of counter-mounted lavatories.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For lavatories and faucets to include in operation and maintenance manuals.

1. In addition to items specified in Section 01 78 23 "Operation and Maintenance Data," include the following:

a. Servicing and adjustments of automatic faucets.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Faucet Washers and O-Rings: Equal to 10 percent of amount of each type and size installed.
2. Faucet Cartridges and O-Rings: Equal to 5 percent of amount of each type and size installed.

PART 2 - PRODUCTS

2.1 LAVATORY SYSTEMS

A. Lavatory System - Multiple Stations:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Bradley Corporation.
    b. Excel Dryer Inc.
    c. Lovair.
    d. Sloan Valve Company.

2. Standards: ASME A112.18.1/CSA B125.1, ANSI A117.1, CSA B45.5/IAPMO Z124, NSF 61, NSF 372, and UPC, IPC, and GREENGUARD Certified.
3. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
4. Bowl(s) and Counter:

    a. Material: Solid-surface or natural quartz surface.
    b. Height to Rim: 34 inches above floor.
    c. Color or Finish: Limestone.
    d. Access Panel: 16-1/8-inch access panel.
    e. Mounting: Wall hung.
    f. Number of Stations: Two.
    g. Drain: Grid with NPS 1-1/2 tailpiece, each bowl.

5. Pedestal: Not required.
6. Faucets:

    a. Type: Wash Bar, brushed brass each station.
    b. Control: Hardwired, sensor-actuated mixing valve with check stops for each user station.

7. Mixer Point-of-Use:

    a. Material: Solid bimetal (bronze, brass, stainless steel).
    b. Security: Hot limit stop set to a maximum of 109.4 deg F.
    c. Set: Screwdriver adjustment temperature dial with scale: Cold-hot.
    d. Operation: Electronic "no-touch" hardwired powered.
    e. Power: 120 V ac.

8. High-Speed, Warm-Air Hand Dryer:

    a. Not Require.

9. Liquid-Soap Dispensers: Hardwired, sensor actuated, for each user station.

10. Lavatory System Mounting: Off floor on wall brackets and frame enclosure.
11. Supply Fittings:

    a. Piping: NPS 1/2 copper tubing, each bowl.
    b. Valves: Shutoff valve on each supply.
    c. Supply Piping: From wall.

12. Waste Fittings:

    a. Standard: ASME A112.18.2/CSA B125.2.
    b. Trap and Drain Piping: NPS 1-1/2, each station.

2.2 VITREOUS-CHINA, UNDER-MOUNTED LAVATORIES

A. Lavatory: Rectangular, vitreous china, undercounter mounted.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. American Standard America.
    b. Crane Plumbing, L.L.C.
    c. Gerber Plumbing Fixtures LLC.
    d. Kohler Co.

2. Fixture:

    a. Standard: ASME A112.19.2/CSA B45.1.
    b. Type: For undercounter mounting.
    c. Nominal Size: Rectangular, 17 by 13 inches.
    d. Faucet-Hole Punching: No holes.
    e. Faucet-Hole Location: On countertop.
    f. Color: White.
    g. Overflow: Required.
    h. Mounting Material: Sealant and undercounter mounting kit.

3. Faucet: "Solid-Brass, Automatically Operated Lavatory Faucets" Article.

2.3 VITREOUS-CHINA, WALL-MOUNTED LAVATORIES

A. Lavatory: Vitreous china, wall mounted.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. American Standard.
    b. Crane Plumbing, L.L.C.
    c. Gerber Plumbing Fixtures LLC.
    d. Kohler Co.

2. Fixture:

    a. Standard: ASME A112.19.2/CSA B45.1.
    b. Type: For wall hanging.
    c. Nominal Size: Oval, 20 by 18 inches.

d. Faucet-Hole Punching: One hole.
e. Faucet-Hole Location: Top.
f. Color: White.
g. Mounting Material: Chair carrier.

3. Faucet: Solid-Brass, Automatically Operated Lavatory Faucets.
4. Support: Type II, concealed-arm lavatory carrier.
5. Lavatory Mounting Height: Standard and Handicapped/elderly according to ICC A117.1, see drawings.

2.4 SOLID-BRASS, AUTOMATICALLY OPERATED LAVATORY FAUCETS

A. Lavatory faucets intended to convey or dispense water for human consumption are to comply with the U.S. Safe Drinking Water Act (SDWA), requirements of the Authority Having Jurisdiction (AHJ), and with NSF 61/NSF 372, or be certified in compliance with NSF 61/NSF 372 by an American National Standards Institute (ANSI) accredited third-party certification body, that the weighted average lead content at wetted surfaces is less than or equal to 0.25 percent.

B. Lavatory Faucets - Automatic Type: Battery Electronic Sensor Operated, Mixing:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. American Standard.
b. Chicago Faucets; Geberit Group.
c. Gerber Plumbing Fixtures LLC.
d. Kohler Co.
e. Moen Incorporated.
f. Sloan Valve Company.
g. T&S Brass and Bronze Works, Inc.
h. The Splash Lab.
i. TOTO USA, INC.

2. Standards: ASME A112.18.1/CSA B125.1 and UL 1951.
3. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
4. General: Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture hole punchings; coordinate outlet with spout and fixture receptor.
5. Body Type: Single hole.
6. Body Material: Commercial, solid-brass, or die-cast housing with brazed copper and brass waterway.
7. Finish: Brushed brass.
8. Maximum Flow Rate: 0.35 gpm.
9. Mounting Type: Deck, concealed.
10. Spout: Rigid type.
11. Spout Outlet: Aerator.
12. Drain: Not part of faucet.

2.5 SUPPLY FITTINGS

A. NSF Standard: Comply with NSF 372 for supply-fitting materials that will be in contact with potable water.

B. Standard: ASME A112.18.1/CSA B125.1.

C. Supply Piping: Chrome-plated-brass pipe or chrome-plated copper tube matching water-supply piping size. Include chrome-plated-brass or stainless-steel wall flange.

D. Supply Stops: Chrome-plated-brass, one-quarter-turn, ball-type or compression valve with inlet connection matching supply piping.

E. Operation: Loose key.

F. Risers:

1. NPS 1/2.
2. ASME A112.18.6, braided- or corrugated-stainless-steel, flexible hose riser.

2.6 WASTE FITTINGS

A. Standard: ASME A112.18.2/CSA B125.2.

B. Drain: Grid type with NPS 1-1/4 offset and straight tailpiece.

C. Trap:

1. Size: NPS 1-1/2 by NPS 1-1/4.
2. Material: Chrome-plated, two-piece, cast-brass trap and swivel elbow with 0.032-inch-thick brass tube to wall; and chrome-plated, brass wall flange.

2.7 SUPPORTS

A. Type II Lavatory Carrier:

1. Standard: ASME A112.6.1M.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before lavatory installation.

B. Examine counters and walls for suitable conditions where lavatories will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install lavatories level and plumb according to roughing-in drawings.

B. Install supports, affixed to building substrate, for wall-mounted lavatories.

C. Install accessible wall-mounted lavatories at handicapped/elderly mounting height for people with disabilities or the elderly, according to ICC/ANSI A117.1.

D. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 22 05 18 "Escutcheons for Plumbing Piping."

E. Seal joints between lavatories, counters, and walls using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 07 92 00 "Joint Sealants."

F. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible lavatories. Comply with requirements in Section 22 07 19 "Plumbing Piping Insulation."

3.3 CONNECTIONS

A. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

B. Comply with water piping requirements specified in Section 22 11 16 "Domestic Water Piping."

C. Comply with soil and waste piping requirements specified in Section 22 13 16 "Sanitary Waste and Vent Piping."

3.4 ADJUSTING

A. Operate and adjust lavatories and controls. Replace damaged and malfunctioning lavatories, fittings, and controls.

B. Adjust water pressure at faucets to produce proper flow.

C. Install fresh batteries in battery-powered, electronic-sensor mechanisms.

3.5 CLEANING AND PROTECTION

A. After completing installation of lavatories, inspect and repair damaged finishes.

B. Clean lavatories, faucets, and other fittings with manufacturers' recommended cleaning methods and materials.

C. Provide protective covering for installed lavatories and fittings.

D. Do not allow use of lavatories for temporary facilities unless approved in writing by Owner.

END OF SECTION

SECTION 22 42 16.16 - COMMERCIAL SINKS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Service basins.
2. Utility sinks.
3. Sink faucets.
4. Supply fittings.
5. Waste fittings.
6. Supports.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for sinks.
2. Include rated capacities, operating characteristics and furnished specialties and accessories.

B. Sustainable Design Submittals:

1. Product Data: For water consumption.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Counter cutout templates for mounting of counter-mounted sinks.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For sinks to include in maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Faucet Washers and O-Rings: Equal to 10 percent of amount of each type and size installed.
2. Faucet Cartridges and O-Rings: Equal to 5 percent of amount of each type and size installed.

PART 2 - PRODUCTS

2.1 SERVICE BASINS

A. Service Basins: Molded Stone, floor mounted.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Acorn Engineering Company.
    b. Crane Plumbing, L.L.C.
    c. Fiat Products.
    d. Florestone Products Co., Inc.
    e. Stern Williams.

2. Fixture:

    a. Standard: IAPMO PS 99.
    b. Shape: Square.
    c. Nominal Size: 24 by 24 inches.
    d. Height: 12 inches.
    e. Tiling Flange: On two sides.
    f. Rim Guard: On all top surfaces.
    g. Color: Not applicable.
    h. Drain: Grid with NPS 3 outlet.

3. Mounting: On floor and flush to wall.
4. Sink Faucets:

    a. NSF Standard: Comply with NSF/ANSI 61, "Drinking Water System Components - Health Effects," for faucet-spout materials that will be in contact with potable water.
    b. Sink Faucets: Manual type, two-lever-handle mixing valve.
    c. General-Duty, Solid-Brass Faucets.
    d. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

        1) Bradley Corporation.
        2) Chicago Faucets.
        3) Speakman Company.
        4) T & S Brass and Bronze Works, Inc.

    e. Standard: ASME A112.18.1/CSA B125.1.
    f. General: Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture; coordinate outlet with spout and sink receptor.
    g. Body Type: Widespread.
    h. Body Material: Commercial, solid brass.
    i. Finish: Polished chrome plate.
    j. Maximum Flow Rate: 2.2 gpm.
    k. Handle(s): Wrist blade, 4 inches.
    l. Mounting Type: Back/wall, exposed.
    m. Spout Type: Rigid, solid brass with wall brace.
    n. Vacuum Breaker: Required for hose outlet.
    o. Spout Outlet: Hose thread according to ASME B1.
    p. Integral Check Valves: Required.

B. Service Sinks - Enameled Cast Iron, Trap Standard Mounted:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. American Standard.
    b. Commercial Enameling Company.
    c. Kohler Co.
    d. Zurn Industries, LLC.

2. Source Limitations: Obtain sinks from single source from single manufacturer.
3. Fixture:

    a. Standard: ASME A112.19.1/CSA B45.2.
    b. Type: Service sink with back.
    c. Back: Plain.
    d. Nominal Size: 24 by 20 inches.
    e. Color: White.
    f. Mounting: NPS 3 P-trap standard with grid strainer inlet, cleanout, and floor flange.
    g. Rim Guard: On front and sides.

4. Faucet: Sink Faucets:

    a. NSF Standard: Comply with NSF/ANSI 61, "Drinking Water System Components - Health Effects," for faucet-spout materials that will be in contact with potable water.
    b. Sink Faucets: Manual type, two-lever-handle mixing valve.
    c. General-Duty, Solid-Brass Faucets.
    d. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

        1) Bradley Corporation.
        2) Chicago Faucets.
        3) Speakman Company.
        4) T & S Brass and Bronze Works, Inc.

    e. Standard: ASME A112.18.1/CSA B125.1.
    f. General: Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture; coordinate outlet with spout and sink receptor.
    g. Body Type: Widespread.
    h. Body Material: Commercial, solid brass.
    i. Finish: Polished chrome plate.
    j. Maximum Flow Rate: 2.2 gpm.
    k. Handle(s): Wrist blade, 4 inches.
    l. Mounting Type: Back/wall, exposed.
    m. Spout Type: Rigid, solid brass with wall brace.
    n. Vacuum Breaker: Required for hose outlet.
    o. Spout Outlet: Hose thread according to ASME B1.
    p. Integral Check Valves: Required.

5. Support: Sink carrier.

C. Utility Sinks: Stainless steel, under mounted.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Advance Tabco.
   b. Eagle Group.
   c. Elkay Manufacturing Co.
   d. Griffin Products, Inc.
   e. Just Manufacturing.
   f. Kohler Co.

2. Fixture:

   a. Standard: ASME A112.19.3/CSA B45.4.
   b. Number of Compartments: One.
   c. Overall Dimensions: See Equipment Schedules.
   d. Metal Thickness: 0.050 inch.
   e. Compartment:

      1) Drain: Grid with NPS 1-1/2 tailpiece and drain grid.
      2) Drain Location: Centered in compartment.

3. Sink Faucets:

   a. NSF Standard: Comply with NSF/ANSI 61, "Drinking Water System Components - Health Effects," for faucet-spout materials that will be in contact with potable water.
   b. Three function, pull-out sprayhead with touch control.
   c. Braided hose with swiveling ball joint.
   d. Sink Faucets: Single level handle with three function, pull-out sprayhead with touch control.
   e. General-Duty, Solid-Brass Faucets.
   f. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

      1) Bradley Corporation.
      2) Chicago Faucets.
      3) Kohler.
      4) Speakman Company.
      5) T & S Brass and Bronze Works, Inc.

   g. Standard: ASME A112.18.1/CSA B125.1.
   h. General: Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture; coordinate outlet with spout and sink receptor.
   i. Body Type: One Hole
   j. Body Material: Commercial, solid brass.
   k. Finish: Brushed brass.
   l. Maximum Flow Rate: 1.5 gpm.
   m. Mounting Type: Deck, exposed.
   n. Vacuum Breaker: Not Required.

4. Supply Fittings:
   a.
   b. Standard: ASME A112.18.1/CSA B125.1.
   c. NSF Standard: Comply with NSF/ANSI 61 – Drinking Water System Components, Health Effects for supply-fitting materials that will be in contact with potable water.
   d. Supplies: Chrome-plated brass compression stop with inlet connection matching water-supply piping type and size.

      1) Operation: Loose key.
      2) Risers: NPS 1/2, ASME A112.18.6, braided or corrugated stainless-steel flexible hose.

5. Waste Fittings:
   a. Standard: ASME A112.18.2/CSA B125.2.
   b. Trap(s):

      1) Size: NPS 1-1/2.
      2) Material: Chrome-plated, two-piece, cast-brass trap and swivel elbow with 0.032-inch-thick brass tube to wall; and chrome-plated brass or steel wall flange.

6. Mounting: On deck with sealant.

2.2 SUPPORTS

A. Type II Sink Carrier:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Jay R. Smith Mfg. Co.
   b. Josam Company.
   c. MIFAB, Inc.
   d. Wade Drains.
   e. WATTS.

2. Standard: ASME A112.6.1M.

2.3 GROUT

A. Standard: ASTM C1107/C1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

B. Characteristics: Nonshrink; recommended for interior and exterior applications.

C. Design Mix: 5000-psi, 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before sink installation.

B. Examine walls, floors, and counters for suitable conditions where sinks will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install sinks level and plumb according to roughing-in drawings.

B. Install supports, affixed to building substrate, for wall-hung sinks.

C. Install accessible wall-mounted sinks at handicapped/elderly mounting height according to ICC/ANSI A117.1.

D. Set floor-mounted sinks in leveling bed of cement grout.

E. Install water-supply piping with stop on each supply to each sink faucet.

1. Exception: Use ball valves if supply stops are not specified with sink. Comply with valve requirements specified in Section 22 05 23.12 "Ball Valves for Plumbing Piping."
2. Install stops in locations where they can be easily reached for operation.

F. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 22 05 18 "Escutcheons for Plumbing Piping."

G. Seal joints between sinks and counters, floors, and walls using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 07 92 00 "Joint Sealants."

H. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible sinks. Comply with requirements in Section 22 07 19 "Plumbing Piping Insulation."

3.3 CONNECTIONS

A. Connect sinks with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

B. Comply with water piping requirements specified in Section 22 11 16 "Domestic Water Piping."

C. Comply with soil and waste piping requirements specified in Section 22 13 16 "Sanitary Waste and Vent Piping."

3.4 ADJUSTING

A. Operate and adjust sinks and controls. Replace damaged and malfunctioning sinks, fittings, and controls.

B. Adjust water pressure at faucets to produce proper flow.

3.5 CLEANING AND PROTECTION

A. After completing installation of sinks, inspect and repair damaged finishes.

B. Clean sinks, faucets, and other fittings with manufacturers' recommended cleaning methods and materials.

C. Provide protective covering for installed sinks and fittings.

D. Do not allow use of sinks for temporary facilities unless approved in writing by Owner.

END OF SECTION

THIS PAGE IS INTENTIONALLY LEFT BLANK.

SECTION 22 42 23 - COMMERCIAL SHOWERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Individual showers.
2. Shower heads and shower valves.
3. Shower basins.
4. Grout.

1.3 DEFINITIONS

A. FRP: Fiberglass-reinforced plastic.

B. PMMA: Polymethyl methacrylate; also known as "acrylic."

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for showers and basins.
2. Include rated capacities, operating characteristics, and furnished specialties and accessories.

B. Sustainable Design Submittals:

1. Plumbing Fixtures: Provide manufacturer's cut sheets for plumbing fixtures indicating flush or flow rates.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For shower valves to include in maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Shower Valve Washers and O-Rings: Equal to 10 percent of amount of each type and size installed.
2. Shower Valve Cartridges and O-Rings: Equal to 5 percent of amount of each type and size installed.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Shower valves intended to convey or dispense water for human consumption are to comply with the U.S. Safe Drinking Water Act (SDWA), with requirements of the Authority Having Jurisdiction (AHJ), and with NSF 61 and NSF 372, or be certified in compliance with NSF 61 and NSF 372 by an ANSI-accredited third-party certification body, in that the weighted average lead content at wetted surfaces is less than or equal to 0.25 percent.

2.2 SHOWER HEADS AND SHOWER VALVES

A. Shower Head with Single-Handle, Thermostatic/Pressure-Balancing Mixing Valve:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Chicago Faucets; Geberit Group.
b. Lawler Manufacturing Company, Inc.
c. POWERS; A WATTS Brand.

2. Source Limitations: Obtain shower heads and shower valves from single source from single manufacturer.
3. Description: Single-handle, accessible, thermostatic/pressure-balancing mixing valve with hot- and cold-water indicators; diverting valve check stops; and hose with handheld shower head on sliding rod shower head.
4. Shower Valve:

a. Standards: ASME A112.18.1/CSA B125.1 and ASSE 1016/ASME A112.1016/CSA B125.16.
b. Body Material: Solid brass.
c. Finish: Polished chrome plate.
d. Mounting: Exposed.
e. Operation: Single-handle, twist or rotate control.
f. Antiscald Device: Integral with mixing valve.
g. Check Stops: Check-valve type, integral with or attached to body; on hot- and cold-water supply connections.

5. Supply Connections: NPS 1/2.

6. Shower Head:

    a. Standard: ASME A112.18.1/CSA B125.1.
    b. Type: Ball joint and head integral with mounting flange or Integral with mounting flange.
    c. EPA WaterSense: Required.
    d. Shower Head Maximum Flow Rate: 1.5 gpm
    e. Shower Head Material: Metallic with chrome-plated finish.
    f. Spray Pattern: Fixed.
    g. Integral Volume Control: Not required.
    h. Temperature Indicator: Not required.

2.3 SHOWER BASINS

A. PMMA Shower Basins:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. American Standard.
    b. Florestone Products Co., Inc.
    c. Freedom Showers.
    d. Kohler Co.
    e. Royal Baths Manufacturing Co.
    f. Swan Surfaces LLC (Swanstone).

2. Source Limitations: Obtain shower basins from single source from single manufacturer.
3. Description: PMMA base for built-up-type shower fixture.
4. Standard: CSA B45.5/IAPMO Z124.
5. Type: Handicapped/accessible, barrier-free threshold.
6. Nominal Size and Shape: See Equipment Schedules, varies.
7. Color: White.
8. Outlet: Drain with NPS 2 outlet.

2.4 GROUT

A. Standard: ASTM C1107/C1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

B. Characteristics: Nonshrink; recommended for interior and exterior applications.

C. Design Mix: 5000 psi, 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine rough-in of water-supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before shower installation.

B. Examine walls and floors for suitable conditions where showers will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Assemble shower components according to manufacturers' written instructions.

B. Install showers level and plumb.

C. Install ball valves in water-supply piping to the shower if supply stops are specified with the shower valve. Comply with valve requirements specified in Section 220523.12 "Ball Valves for Plumbing Piping." Install valves in locations that are accessible for ease of operation.

D. Install shower flow-control fittings with specified maximum flow rates in shower arms.

E. Set shower receptors and shower basins in leveling bed of cement grout.

F. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheons requirements specified in Section 220518 "Escutcheons for Plumbing Piping."

G. Seal joints between showers and floors and walls using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

3.3 PIPING CONNECTIONS

A. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."

C. Comply with traps and soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."

3.4 ADJUSTING

A. Operate and adjust showers and controls. Replace damaged and malfunctioning showers, fittings, and controls.

B. Adjust water pressure at shower valves to produce proper flow.

3.5 CLEANING AND PROTECTION

A. After completing installation of showers and basins, inspect and repair damaged finishes.

B. Clean showers and basins, shower valves, and other fittings with manufacturers' recommended cleaning methods and materials.

C. Provide protective covering for installed fixtures and fittings.

D. Do not allow use of showers and basins for temporary facilities unless approved in writing by Owner.

END OF SECTION

THIS PAGE IS INTENTIONALLY LEFT BLANK.

SECTION 22 45 00 - EMERGENCY PLUMBING FIXTURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Combination units.
2. Water-tempering equipment.

1.3 DEFINITIONS

A. Accessible Fixture: Emergency plumbing fixture that can be approached, entered, and used by people with disabilities.

B. Plumbed Emergency Plumbing Fixture: Fixture with fixed, potable-water supply.

C. Tepid: Moderately warm.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include flow rates and capacities, furnished specialties, and accessories.

B. Shop Drawings:

1. Include plans, elevations, sections, and mounting details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

A. Product Certificates: Submit certificates of performance testing specified in "Source Quality Control" Article.

B. Field quality-control test reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For emergency plumbing fixtures to include in operation and maintenance manuals.

1.7 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. ANSI Standard: Comply with ANSI Z358.1, "Emergency Eyewash and Shower Equipment."

C. NSF Standard: Comply with NSF 61 Annex G, "Drinking Water System Components - Health Effects," for fixture materials that will be in contact with potable water.

D. Regulatory Requirements: Comply with requirements in ICC/ANSI A117.1, "Accessible and Usable Buildings and Facilities"; Public Law 90-480, "Architectural Barriers Act"; and Public Law 101-336, "Americans with Disabilities Act"; for plumbing fixtures for people with disabilities.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. ISEA Standard: Comply with ISEA Z358.1.

C. NSF Standard: Comply with NSF 61 and NSF 372, for fixture materials that will be in contact with potable water.

D. Regulatory Requirements: Comply with requirements in ICC A117.1; Public Law 90-480, "Architectural Barriers Act"; and Public Law 101-336, "Americans with Disabilities Act"; for plumbing fixtures for people with disabilities.

2.2 COMBINATION UNITS

A. Standard, Plumbed Emergency Shower with Eyewash Combination Units:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Acorn Safety.
    b. Bradley Corporation.
    c. Guardian Equipment Co.
    d. Haws Corporation.
    e. Speakman Company.

2. Piping:

    a. Material: Chrome-plated brass or stainless steel.
    b. Unit Supply: NPS 1-1/4 minimum.
    c. Unit Drain: Outlet at back or side near bottom.

3. Shower:

    a. Capacity: Not less than 20 gpm for at least 15 minutes.
    b. Supply Piping: NPS 1 with flow regulator and stay-open control valve.

c. Control-Valve Actuator: Pull rod.
d. Shower Head: 8-inch-minimum diameter, chrome-plated brass or stainless steel.
e. Mounting: Pedestal.

4. Eyewash Unit:

a. Capacity: Not less than 0.4 gpm for at least 15 minutes.
b. Supply Piping: NPS 1/2 with flow regulator and stay-open control valve.
c. Control-Valve Actuator: Paddle.
d. Spray-Head Assembly: Two receptor-mounted spray heads.
e. Receptor: Chrome-plated brass or stainless-steel bowl.
f. Mounting: Attached shower pedestal.

2.3 WATER-TEMPERING EQUIPMENT

A. Hot- and Cold-Water, Water-Tempering Equipment:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Acorn Safety.
b. Bradley Corporation.
c. Guardian Equipment Co.
d. Haws Corporation.
e. Lawler Manufacturing Company, Inc.
f. Leonard Valve Company.
g. POWERS; A WATTS Brand.
h. Speakman Company.

2. Description: Factory-fabricated equipment with thermostatic mixing valve.

a. Thermostatic Mixing Valve: Designed to provide 85 deg F tepid, potable water at emergency plumbing fixtures, to maintain temperature at plus or minus 5 deg F throughout required 15-minute test period, and in case of unit failure to continue cold-water flow, with union connections, controls, metal piping, and corrosion-resistant enclosure.
b. Supply Connections: For hot and cold water.

2.4 SOURCE QUALITY CONTROL

A. Certify performance of emergency plumbing fixtures by independent testing organization acceptable to authorities having jurisdiction.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for water piping systems to verify actual locations of piping connections before plumbed emergency plumbing fixture installation.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF EMERGENCY PLUMBING FIXTURE INSTALLATION

A. Assemble emergency plumbing fixture piping, fittings, control valves, and other components.

B. Install fixtures level and plumb.

C. Fasten fixtures to substrate.

D. Install shutoff valves in water-supply piping to fixtures, to facilitate maintenance of the equipment. Use ball valve if specific type valve is not indicated. Install valves chained or locked in open position if permitted. Install valves in locations where they can easily be reached for operation. Comply with requirements for valves specified in Section 22 05 23.12 "Ball Valves for Plumbing Piping."

1. Exception: Omit shutoff valve on supply to emergency equipment if prohibited by authorities having jurisdiction.

E. Install dielectric fitting in supply piping to emergency equipment if piping and equipment connections are made of different metals. Comply with requirements for dielectric fittings specified in Section 22 11 16 "Domestic Water Piping."

F. Install thermometers in supply and outlet piping connections to water-tempering equipment. Comply with requirements for thermometers specified in Section 22 05 19 "Meters and Gages for Plumbing Piping."

G. Install trap and waste piping on drain outlet of emergency equipment receptors that are indicated to be directly connected to drainage system. Comply with requirements for waste piping specified in Section 22 13 16 "Sanitary Waste and Vent Piping."

H. Install indirect waste piping on drain outlet of emergency equipment receptors that are indicated to be indirectly connected to drainage system. Comply with requirements for waste piping specified in Section 22 13 16 "Sanitary Waste and Vent Piping."

I. Install escutcheons on piping wall and ceiling penetrations in exposed, finished locations. Comply with requirements for escutcheons specified in Section 22 05 18 "Escutcheons for Plumbing Piping."

3.3 CONNECTIONS

A. Connect hot- and cold-water-supply piping to hot- and cold-water, water-tempering equipment. Connect output from water-tempering equipment to emergency plumbing fixtures. Comply with requirements for hot- and cold-water piping specified in Section 22 11 16 "Domestic Water Piping."

B. Indirectly connect emergency plumbing fixture receptors without trapped drain outlet to sanitary waste or storm drainage piping.

C. Where installing piping adjacent to emergency plumbing fixtures, allow space for service and maintenance of fixtures.

3.4 IDENTIFICATION

A. Install equipment nameplates or equipment markers on emergency plumbing fixtures and equipment and equipment signs on water-tempering equipment. Comply with requirements for

identification materials specified in Section 22 05 53 "Identification for Plumbing Piping and Equipment."

3.5 FIELD QUALITY CONTROL

A. Mechanical-Component Testing: After plumbing connections have been made, test for compliance with requirements. Verify ability to achieve indicated capacities.

B. Tests and Inspections:

1. Perform each visual and mechanical inspection.
2. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
3. Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Emergency plumbing fixtures and water-tempering equipment will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

3.6 ADJUSTING

A. Adjust or replace fixture flow regulators for proper flow.

B. Adjust equipment temperature settings.

END OF SECTION

THIS PAGE INTENTIONALLY LEFT BLANK.

SECTION 22 47 16 - PRESSURE WATER COOLERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes pressure water coolers and related components.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of pressure water cooler.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Sustainable Design Submittals:

1. Product Data: For water consumption.

C. Shop Drawings: Include diagrams for power, signal, and control wiring.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For pressure water coolers to include in maintenance manuals.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Filter Cartridges: Equal to 100 percent of quantity installed for each type and size indicated, but no fewer than 2 of each.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Standards:

1. Pressure water coolers and bottle filling stations intended to convey or dispense water for human consumption are to comply with the U.S. Safe Drinking Water Act (SDWA), requirements of the Authority Having Jurisdiction (AHJ), and with NSF 61 or NSF 372, or be certified in compliance with NSF 61 or NSF 372 by an ANSI-accredited third-party certification body, that the weighted average lead content at wetted surfaces is less than or equal to 0.25 percent.

2. Comply with ASHRAE 34 for water coolers. Provide HFC 134a (tetrafluoroethane) refrigerant unless otherwise indicated.
3. Comply with UL 399.
4. Comply with ASME A112.19.3/CSA B45.4.
5. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
6. Comply with NSF 42 and NSF 53 for water filters for water coolers and bottle filling stations.
7. Comply with ICC A117.1 for accessible water coolers and bottle filling stations.

2.2 PRESSURE WATER COOLERS

A. Pressure Water Coolers: Surface, Wall-Mounted, Stainless Steel, wheelchair accessible, bi-level with bottle filler.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Elkay Manufacturing Co.
    b. Halsey Taylor.
    c. Haws Corporation.

2. Standards:

    a. Comply with NSF 61 and NSF 372.
    b. Comply with ASHRAE 34, "Designation and Safety Classification of Refrigerants," for water coolers. Provide HFC 134a (tetrafluoroethane) refrigerant unless otherwise indicated.
    c. Comply with ICC A117.1.

3. Cabinet: All stainless steel.
4. Bubbler: One, with adjustable stream regulator, located on deck.
5. Control: [Push button or Push bar.
6. Drain: Grid with NPS 1-1/4 tailpiece.
7. Supply: NPS 3/8 with shutoff valve.
8. Waste Fitting: ASME A112.18.2/CSA B125.2, NPS 1-1/4 brass P-trap.
9. Filter: One or more water filters complying with NSF 42 and NSF 53 for cyst and lead reduction to below EPA standards; with capacity sized for unit peak flow rate.
10. Cooling System: Electric, with precooler, hermetically sealed compressor, cooling coil, air-cooled condensing unit, corrosion-resistant tubing, refrigerant, corrosion-resistant-metal storage tank, and adjustable thermostat.

    a. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

11. Capacities and Characteristics:

    a. See Equipment Schedules.

12. Ventilation Grille: Stainless steel.
13. Support: Mounting frame for attaching to substrate.

2.3 SUPPORTS

A. Type I Water Cooler Carrier:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Jay R. Smith Mfg. Co.
b. Josam Company.
c. MIFAB, Inc.
d. Wade Drains.
e. WATTS.

2. Standard: ASME A112.6.1M.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for water-supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before fixture installation.

B. Examine walls and floors for suitable conditions where fixtures will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install fixtures level and plumb according to roughing-in drawings. For fixtures indicated for children, install at height required by authorities having jurisdiction.

B. Install off-the-floor carrier supports, affixed to building substrate, for wall-mounted fixtures.

C. Install mounting frames, affixed to building construction, and attach recessed, pressure water coolers, and in-wall bottle filling stations to mounting frames.

D. Install water-supply piping with shutoff valve on supply to each fixture to be connected to domestic-water distribution piping. Use ball or gate valve. Install valves in locations where they can be easily reached for operation. Valves are specified in Section 22 05 23.12 "Ball Valves for Plumbing Piping" and Section 22 05 23.15 "Gate Valves for Plumbing Piping."

E. Install trap and waste piping on drain outlet of each fixture to be connected to sanitary drainage system.

F. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons where required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 22 05 18 "Escutcheons for Plumbing Piping."

G. Seal joints between fixtures and walls using sanitary-type, one-part, mildew-resistant, silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 07 92 00 "Joint Sealants."

3.3 CONNECTIONS

A. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

B. Comply with water piping requirements specified in Section 22 11 16 "Domestic Water Piping."

C. Install ball shutoff valve on water supply to each fixture. Install valve upstream from filter for water cooler. Comply with valve requirements specified in Section 22 05 23.12 "Ball Valves for Plumbing Piping."

D. Comply with soil and waste piping requirements specified in Section 22 13 16 "Sanitary Waste and Vent Piping."

3.4 ADJUSTING

A. Adjust fixture flow regulators for proper flow and stream height.

B. Adjust pressure water-cooler temperature settings.

3.5 CLEANING

A. After installing fixture, inspect unit. Remove paint splatters and other spots, dirt, and debris. Repair damaged finish to match original finish.

B. Clean fixtures, on completion of installation, according to manufacturer's written instructions.

C. Provide protective covering for installed fixtures.

D. Do not allow use of fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION

SECTION 23 05 01 - MECHANICAL AND ELECTRICAL COORDINATION 23 05 01 AND 26 05 01

PART 1 - GENERAL

1.1 RESPONSIBILITY

A. The Divisions 21 through 23, 26 through 28 contractor(s) shall comply with the provisions of this section. The Divisions 21 through 23 contractor(s) shall verify electrical service provided by the electrical contractor before ordering any mechanical equipment requiring electrical connections. Provide submittals of all mechanical equipment to Division 26 through 28 contractor(s).

B. The final responsibility for properly coordinating the electrical work of this section shall belong to the Divisions 21 through 23 system contractor performing the work, which requires the electrical power.

1. Each Divisions 21 through 23 contractor shall be responsible for providing power wiring for certain devices as described in the specifications and on the drawings. This work shall be provided by a licensed electrician in accordance with all of the applicable provisions of the Division 26 through 28 specifications, NEC and local codes.

1.2 WORK INCLUDED

A. Carefully coordinate the interface between Divisions 21 through 23 (Mechanical) and Divisions 26 through 28 (Electrical), and Division 23 09 00 (Building Management and Automatic Temperature Control Systems) before submitting any equipment for review or commencing installation

1.3 DEFINITIONS

A. Automatic: Pertaining to a function, operation, process or device that, under specified conditions, functions without intervention by human operator.

B. Disconnect Switch: A mechanical switching device used for changing the connections in a circuit, or for isolating a circuit or equipment from a power source.

C. Motor Control Center: A floor-mounted assembly of one or more enclosed vertical sections having a common horizontal power bus and primarily containing motor starting units.

D. Control Circuit/Power: The circuit which carries the electrical signals of a control apparatus or system directing the performance of the controller but does not carry the main power circuit.

E. Manual Operation: Operation by hand without the use of any other power.

F. MC: Mechanical Contractor = Divisions 21 through 23 Contractor who furnishes motor.

G. TC: Temperature Controls = Division 23 09 00 Contractor who furnishes control.

H. EC: Electrical Contractor = Divisions 26 through 28 Contractor.

I. FA: Fire Alarm Contractor = Division 28 Contractor who furnishes Fire Alarm System.

1.4 RESPONSIBILITY SCHEDULE

A. Responsibility: Unless otherwise indicated, all motors and controls for Divisions 21 through 23 equipment shall be furnished, set in place and wired in accordance with the following schedule:

ITEM -	Furnished Under	Set In Place Under	Power Wiring Under	Control Wiring Under
MC: Mechanical Contractor TC: Temperature Contractor EC: Electrical Contractor FA: Fire Alarm Contractor				
AHU Interior Marine Lights	MC	MC	EC	MC
Equipment Motors	MC	MC	EC	--
Automatically or Manually Controlled Starters/Contactors: (Note 4) -Separate -Factory Mounted and Wired	 MC MC	 EC MC	 EC EC	 TC TC
In Motor Control Centers (Note 4)	EC	EC	EC	TC
Motor Speed Controllers: (Note 4) -Separate -Factory Mounted and Wired	 MC MC	 EC MC	 EC EC	 TC TC
Disconnect Switches (Note 1)	EC	EC	EC	--
Thermal Overload Switches (Note 1)	EC	EC	EC	--
Switches (Manual or Automatic other than disconnect) (Note 2)	MC or TC	MC or TC	EC or TC	TC or MC
Control Relays (Note 2)	MC or TC	MC or TC	--	TC
Control Transformers	MC or TC	MC or TC	EC or TC	TC
Push Button Stations, Pilot Lights	MC	EC	EC	EC
Thermostat and Controls: Integral with Equipment or Directly Attached to Ducts, Pipes, etc. (Note 2)	MC or TC	EC or TC	EC or TC	TC
Equipment in Temperature Control Panels	TC	TC	TC	TC
Standalone Control Panels (BAS) (Note 6)	TC	TC	TC	TC
Valve Motors, Damper Motors, Solenoid Valves, etc.	TC	TC	TC	TC
EP Valves or Switches, P.E. Switches, etc.	TC	TC	--	TC
Fire Alarm System (Note 3)	FA	FA	EC	FA
Fire Sprinkler Alarm (Note 3)	MC	MC	EC	FA
Duct System Smoke Detectors (Note 5)	FA	MC	--	TC/FA
Relays for Fan Control via duct detectors (Note 5)	MC	MC	EC	TC
Room Smoke Detectors Including Relays for Fan Control (Note 3)	FA	FA	--	FA
Smoke Management Controls (Note 8)	FA	FA	EC	FA
CO Sensors and Control Panels	TC	TC	TC	TC
Equipment Interlocks	TC	TC	--	TC
Fire/Smoke and Smoke Dampers (Note 7)	MC	MC	EC	FA
Smoke Control Dampers (for smoke management system)	MC	MC	EC	FA/TC

ITEM -	Furnished Under	Set In Place Under	Power Wiring Under	Control Wiring Under
MC: Mechanical Contractor TC: Temperature Contractor EC: Electrical Contractor FA: Fire Alarm Contractor				
Positive Indication Devices (i.e., current sensors, end switches, airflow sensors)	TC	TC	--	FA/TC
Heat Trace Systems (Note 9)	MC	MC	MC	MC
Boiler/Water Heater EPO Shut-off Switch and gas solenoid valve(s). (Note 10)	MC	MC	EC	EC

Notes:

1. If furnished as part of factory wired equipment furnished and set in place by MC, wiring, and connections by EC.
2. If float switches, line thermostats, P.E. switches, time switches, or other controls carry the FULL LOAD CURRENT to any motor, they shall be furnished by MC, but they shall be set in place and connected by EC, except that where such items are an integral part of the mechanical equipment, or directly attached to ducts, piping, or other mechanical equipment, they shall be furnished and set in place by MC and connected by EC. If they do not carry the FULL LOAD CURRENT to any motor, they shall be furnished, set in place and wired by TC contractor.
3. Pre-action system initiation signals (such as smoke detectors or general alarm conditions in a pre-action zone) shall be provided under Division 28.
4. Electrical contractor is responsible for wiring from starter to motor unless factory wired.
5. Temperature control contractor shall provide conduit and wire from auxiliary contact in motor starter to the detector so that the unit shuts down in all operating modes. Fire Alarm Contractor to wire from the detector to fire alarm panel.
6. Each division shall be fully responsible for any control panels as called for on the drawings or specifications.
7. Division 26 shall provide all power and control wiring to fire/smoke or smoke dampers. Division 23 and 26/28 shall provide parallel control wiring (with 28 fire alarm having priority signal) to dampers and equipment utilized in both normal and smoke control modes. Refer to Smoke Control and Fire Alarm Drawings and the Fire Alarm Matrix.

    a. Fire alarm system shall override automated building control system during smoke exhaust mode.
    b. TC wiring to fire/smoke or smoke dampers required only when damper also serves HVAC system.

8. FA wires to components necessary for the operation and monitoring of the Smoke Management System. TC wires to components utilized in the control and monitoring of the Automated Building Control System.
9. Mechanical contractor shall be responsible for fully functional heat trace system. Mechanical contractor shall engage a licensed electrician to install heat trace system. Where applicable, mechanical contractor shall engage temperature controls contractor to install control wiring to Division 23 09 00 system.
10. Electrical contractor to provide shunt trip breaker or contactor to remove power from the equipment.

B. Power Wiring by Divisions 21 through 23 : The electrical power for certain equipment provided under Divisions 21 through 23 has not been specifically indicated on the electrical drawings and must be provided by and field coordinated by the Divisions 21 through 23 trade requiring such power. Sufficient power for this purpose shall be furnished as “spare” dedicated circuit capacity in Division 26’s panelboards. All wiring, conduit and electrical devices downstream of the panelboards are the responsibility of the Divisions 21 through 23 trade requiring the power.

1. Such equipment is hereby defined as:

a. Electrical heat trace. Required heat trace locations, capacities and specification are shown on the plumbing and mechanical drawings (Division 22 and 23 work).
b. Fire protection air compressors, dry-pipe control panels and valves. Required connections are included in the Division 21 work, and will be shown by that contractor’s engineered system design drawings.

1) Pre-action system initiation signals (such as smoke detectors or general alarm conditions in a pre-action zone) shall be provided under Division 28 fire alarm work.
2) Division 21 shall provide pre-action control panel and interconnection between nearest suitable fire alarm panel and location of pre-action valve(s).
3) Division 28 shall provide interconnection between fire command center alarm panel (provided under Division 28) and remote communication fire alarm panel (provided under Division 28).

c. Infrared plumbing fixtures. Fixtures requiring power are shown on the plumbing drawings and schedules. Provide junction box and or receptacle as required by manufacturer.
d. Temperature control panels, control air compressors and line voltage power for 24v control transformers. Required connections are included in Division 23 09 00 and will be shown by that contractor’s control submittal drawings.
e. Condensate pumps. Provide power from associated unit or from nearby panelboard.

1.5 GENERAL REQUIREMENTS

A. Connections:

1. Connections to all controls directly attached to ducts, piping and mechanical equipment shall be made with flexible connections.

B. Starters:

1. Provide magnetic starters for all three phase motors and equipment complete with:

a. Control transformers.
b. 120V holding coils.
c. Integral hand-off-auto switch.
d. Auxiliary contacts required for system operation plus one (1) spare.
e. Refer to Section 23 05 13 Motors, Starters and Drives.

C. Remote Switches and Pushbutton Stations:

1. Provide remote switches and/or pushbutton stations required for manually operated equipment (if no automatic controls have been provided) complete with pilot lights of an approved type lighted by current from load side of starter.

D. Special Requirements:

1. Motors, starters and other electrical equipment installed in moist areas or areas of special conditions, such as explosion proof, shall be designed and approved for installation in such areas with appropriate enclosure.

E. Identification:

1. Provide identification of purpose for each switch and/or pushbutton station furnished. Identification may be either engraved plastic sign permanently mounted to wall below switch, or stamping on switch cover proper. All such identification signs and/or switch covers in finished areas shall match other hardware in the immediate area.

F. Control Voltage:

1. Maximum allowable control voltage 120V. Fully protect control circuit conductors in accordance with National Electrical Code.

G. DDC Control Interface:

1. Fully coordinate the requirements of each division with regard to supplying a complete DDC Control System prior to submitting bid.
2. All control power shall be furnished via dedicated line voltage circuits.
3. Dedicated control circuits from electrical panelboards to DDC control panels and from electrical panelboards to dedicated DDC J-boxes (for distributed control components such as VAV boxes), and control transformer line voltage connections shall be provided under Division 23 09 00 where required and as shown on the drawings.

    a. Exceptions: The following Divisions 21 through 23 equipment has been provided with electrical power feeders downstream of the panelboards by Division 26:

        1) Division 28 , Fire Alarm System Panels.
        2) Division 23 09 00 , Building Automation System (BAS):

            a) Each air handling unit (AHU) has been provided with a dedicated combination control and unit lighting circuit(s) to its air handling room.
            b) Certain BAS panels requiring emergency power.
            c) BAS workstations and file servers in the engineer’s office and fire command center.

        3) See the drawings for additional exceptions.

4. Low-voltage wiring from J-boxes to distributed control components, all low-voltage connections, all control panels and all control transformers (not part of unitary equipment) shall be provided under Division 23 09 00 .
5. Any additional power requirements shall be the responsibility of the Division 23 09 00 Contractor requiring same, and provided at no additional cost to the owner.

H. Short Circuit Current Ratings

1. MC shall be responsible for coordinating the Short Circuit Current Ratings (SCCR) of all such equipment with the electrical short circuit study. SCCR for equipment shall be greater than the available fault current, as indicated on electrical one-lines.
2. Utilizing fuses to limit the available fault current is not acceptable.

1.6 CEILING AND CHASE CAVITY PRECEDENCE

A. Coordinate ceiling cavity space carefully with all trades. In the event of conflict, install mechanical and electric systems within the cavity space allocation in the following order of precedence. A system with higher precedence may direct that systems of lower precedence be relocated from space, which is required for expedient routing of the precedent system.

1. Plumbing waste, cooling coil drain piping, and roof drain mains and leaders.
2. Plumbing vent piping.
3. Supply, return and exhaust ductwork.
4. Electrical conduit greater than 4” diameter.
5. Hydronic branch and mains.
6. Domestic water piping.
7. Fire sprinkler mains and leaders.
8. Hydronic branch piping (2” and less).
9. Domestic hot and cold-water branches.
10. Electrical conduit branch feeders.
11. Fire sprinkler branch piping and sprinkler runouts.

B. Light fixtures have precedence in a zone, which is the same height above the ceiling as the depth of the fixture (plus 2”).

C. Examine the contract documents of all trades (e.g. all Divisions 21 through 23 26 through 28 drawings, the architectural floor plans, reflected ceiling plans, elevations and sections, structural plans and sections, etc.).

D. Coordinate necessary equipment, ductwork and piping locations so that the final installation is compatible with the materials and equipment of the other trades.

E. Prepare shop drawings for installation of all new work before installation to verify coordination of work between trades.

F. Provide access doors for all equipment, valves, clean-outs, actuators and controls which require access for adjustment or servicing and which are located in otherwise inaccessible locations.

1. For equipment located in “accessible locations” such as lay-in ceilings: Locate equipment to provide adequate service clearance for normal maintenance without removing architectural, mechanical, electrical or structural elements such as the ceiling support system, electrical fixtures, etc. “Normal maintenance” includes, but is not limited to: filter changing; greasing of bearings; using p/t ports for pressure or temperature measurements; and replacement of ballasts, fuses, etc.

PART 2 - PRODUCTS

2.1 MOTOR HORSEPOWER

A. In general, all motors 1/2 HP and above shall be three phase, all motors less then 1/2 HP shall be single phase.

B. Voltage and phase of motors as scheduled on the electrical drawings shall take precedence in the case of a conflict between the mechanical and electrical drawings or general condition 2.1. A., above.

C. Work under Divisions 21 through 23 includes coordinating the electrical requirements of all mechanical equipment with the requirements of the work under Divisions 26 through 28, before ordering the equipment.

1. If motor horsepowers are changed under the work of Divisions 21 through 23 without a change in duty of the motor's driven device, coordination of additional electrical work (if any) and additional payment for that work (if any) shall be provided under the section of Divisions 21 through 23 initiating the change. Increases or decreases in motor horsepower from that specified shall not be made without written approval from the Architect/Engineer.

PART 3 - EXECUTION – NOT USED

END OF SECTION

This page is intentionally left blank.

SECTION 23 05 02 - BASIC MECHANICAL REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. This Section supplements Division 1 - General Requirements.

B. Where contradictions occur between this Section and Division 1, the more stringent of the two shall apply. Architect/Engineer shall decide which is more stringent.

C. Provisions of this section shall also apply to all sections of Divisions 21 through 23.

1.2 DEFINITIONS

A. The definitions of Division 1 and the General Conditions of this specification also apply to Divisions 21 through 23 contract.

B. “Contract Documents” constitute the drawings, specifications, general conditions, project manuals, etc., prepared by Engineer (or other design professional in association with Engineer) for contractor’s bid or contractor’s negotiations with the Owner. Divisions 21 through 23 drawings and specifications prepared by the Engineer are not construction documents.

C. “Construction Documents”, “construction drawings”, and similar terms for Divisions 21 through 23 work refer to installation diagrams, shop drawings and coordination drawings prepared by the contractor using the design intent indicated on the Engineer’s contract documents. These specifications detail the contractor’s responsibility for “Engineering by Contractor” and for preparation of construction documents.

D. “(N)” indicates "new" equipment to be provided under this contract.

E. “(E)” indicates "existing" equipment on site which may or may not need to be relocated as a part of this work.

F. “(R)” indicates existing equipment to be relocated as part of this work.

G. "Furnish" means to "supply" and usually refers to an item of equipment.

H. "Install" means to "set in place, connect and place in full operational order".

I. "Provide" means to "furnish and install".

J. “Equal” or "Equivalent" means "meets the specifications of the reference product or item in all significant aspects." Significant aspects shall be as determined by the Architect/Engineer.

K. "Work by other(s) divisions"; "re: _____ Division", and similar expressions means work to be performed under the contract documents, but not necessarily under the division or section of the work on which the note appears. It is the contractor's sole responsibility to coordinate the work of the contract between their suppliers, subcontractors, and employees. If clarification is required, consult Architect/Engineer before submitting bid. By inference, any reference to a "contractor" or "sub-contractor" means the entity, which has contracted with the Owner for the work of the Contract Documents.

L. By inference, any reference to a "contractor" or "sub-contractor" means the entity, which has contracted with the owner for the work of the Contract Documents.

M. "Engineer" means the design professional firm, which has prepared these contract documents. All questions, submittals, etc. of this division shall be routed to the Engineer (through proper contractual channels).

1.3 COORDINATION WITHIN DIVISIONS 21 THROUGH 23

A. Contract Documents:

1. General: The Contract Documents are diagrammatic showing certain physical relationships, which must be established within the Divisions 21 through 23 work and its interface with other work. Such establishment is the exclusive responsibility of the Contractor. Drawings shall not be scaled for the purpose of establishing material quantities.
2. Supplemental Instructions: The exact location for some items in this Specification may not be shown on the Drawings. The location of such items may be established by the Architect/Engineer during the progress of the work.
3. Discrepancies:

    a. Examine Drawings and Specifications of all Divisions of the work.
    b. Report any discrepancies to the Architect/Engineer and obtain written instructions before proceeding.
    c. Should there be a conflict within or between the Specifications or Drawings, the more stringent or higher quality requirements shall apply.
    d. Items called for in either specifications or drawings shall be required as if called for in both.

4. Constructability:

    a. Examine Drawings and Specifications of all Divisions of the work.
    b. Report any issues to the Architect/Engineer which may prevent installation of Divisions 21 through 23 work in accordance with the Contract Documents and the original construction contract.
    c. Report all issues within *90 days* after contract.

B. Be responsible for providing proper documentation of equipment product data and shop drawings to all entities providing service. This coordination shall include, but not be limited to the following:

1. Division 21 - Series contractor (Fire Protection Contractor) shall provide shop drawings to all other Division 21 through 23 contractors.

2. Division 23 09 00 and 23 05 93 - Contractors (Automatic Temperature Controls, Building Management and Test-Adjust-Balance Contractors) shall be provided with equipment product data and shop drawings as appropriate from other Division 21 through 23 and Divisions 26 through 28 contractors, and shall furnish the same information about control devices (such as valves, test wells, etc.) to the appropriate Divisions 21 through 23 Contractor.

C. Coordination Drawings:

1. Submit coordination drawings for all Divisions 21 through 23 work. The drawings shall be fully coordinated and signed off by all affected trades prior to submission. The coordination drawings shall include the following at a minimum.

    a. All major ductwork, piping, conduit and equipment.
    b. Reflected ceiling plans with light fixtures.
    c. Current architectural floor plans.
    d. Major structural elements.
    e. Elevations of piping ductwork or equipment.
    f. Sections through critical spaces.

2. The drawings shall be at a suitable scale (1/8”=1’-0” minimum) to clearly show information.
3. Any work installed without reviewed coordination drawings is done at the Contractor’s risk.

D. Electronic Drawings:

1. Electronic drawings are available from ME Engineers. One complete set of electronic drawings in Revit or CAD format to be provided to GC for distribution. Electronic drawings are for reference only and available only upon receipt of electronic document disclaimer.

E. Existing Conditions:

1. Inspect existing conditions prior to bidding.
2. Provide proper coordination of mechanical work with existing conditions.

F. Utility Connections:

1. Coordinate the connection of mechanical system with the Civil drawings and utility companies.
2. Comply with regulations of utility suppliers.
3. The Contract Documents indicate the available information on existing utilities and services, and on new services (if any) to be provided to the project by utility companies and agencies.

    a. Notify Architect/Engineer immediately if discrepancies are found.

4. Coordinate mechanical utility interruptions one week in advance with the Owner and the Utility Company.

    a. Plan work so that duration of the interruption is kept to a minimum.

1.4 COORDINATION WITH OTHER DIVISIONS

A. General:

1. Coordinate Divisions 21 through 23 work to the progress of the work of other trades.
2. Complete the entire installation as soon as the condition of the building will permit.

B. Coordinate ceiling cavity space carefully with all trades. In the event of conflict, install mechanical and electric systems within the cavity space allocation in the following order:

1. Plumbing waste, cooling coil drain, piping and roof drain mains and leaders.
2. Plumbing vent piping.
3. Supply, return and exhaust ductwork.
4. Electrical conduit greater than 4” diameter.
5. Hydronic branch and mains.
6. Domestic water piping.
7. Fire sprinkler mains and leaders.
8. Hydronic branch piping (2” and less).
9. Domestic hot and cold-water branches.
10. Electrical conduit branch feeders.
11. Fire sprinkler branch piping and sprinkler runouts.

C. Coordination with Electrical Work. Refer to Section 23 05 01.

D. Cutting and Patching: Refer to Division 1 and Section 23 05 03.

E. Chases, Inserts and Openings:

1. Provide measurements, drawings, and layouts so that openings, inserts and chases in new construction can be built in as construction progresses.
2. Check sizes and locations of openings provided.

    a. Any cutting and patching made necessary by failure to provide measurements, drawings, and layouts at the proper time shall be done at no additional cost to the Owner.
    b. Coordinate roof openings for all roof-mounted equipment. Openings on documents are diagrammatic and do not represent manufacturer specific requirements. Actual opening size, orientation and location, as well as structural coordination, is the responsibility of the mechanical contractor.
    c. Provide transitions on ductwork to accommodate actual roof openings.

F. Support Dimensions: Provide dimensions and drawings so that concrete bases and other equipment supports to be provided under other Sections of the Specifications can be built at the proper time.

1.5 ENGINEERING BY CONTRACTOR

A. The construction of this building requires the contractor to design several systems or subsystems. All such designs shall be the complete responsibility of the contractor.

B. Systems or subsystems which require engineering responsibility by the contractor include, but are not limited to:

1. Any system not fully detailed on the drawings.
2. Fire sprinkler.
3. Equipment supports, and hangers not fully detailed in the drawings.
4. Pipe hangers, sleeves and anchors not specified in these documents, or cataloged by the manufacturer.
5. Fire stopping
6. Duct supports, hangers and miscellaneous steel as required.
7. Temperature controls.
8. Refrigeration systems.
9. Piping expansion and contraction provisions
10. Sizing and routing of condensate piping.

1.6 REGULATORY REQUIREMENTS

A. Codes: Comply with the following:

1. International Building Code 2018.
2. International Mechanical Code 2018.
3. International Plumbing Code 2018.
4. International Energy Code 2018.
5. National Electric Code (NEC) Latest Edition
6. International Fire Code 2018.
7. ASME Boiler and Pressure Vessel Code.
8. Local Modifications to above Codes.
9. 2019 DGS Procedure Manual for Professional Services

B. Applicable pamphlets of NFPA.

C. Requirements of Local Utility Companies:

1. Comply with rules and regulations of local utility companies. Include in bid the cost of all valves, valve boxes, meter boxes, meters and such accessory equipment which will be required for the project.

D. Other Regulations: Comply with the latest editions of the following:

1. U.S. and State Department of Labor Safety Regulations pertaining to the completed project.
2. Requirements of Fire Departments serving the project.
3. Regulations of the Health Department having jurisdiction.
4. Regulations of the Office of State Fire Marshal.
5. ASHRAE Energy Conservation Standard 90A.
6. ASHRAE Ventilation Standard 62.
7. Americans with Disabilities Act (ADA).
8. Clean Air Act.
9. Clean Water Act.

10. USGBC LEED-NC v4.0.

    a. In particular, all sealants and adhesives shall be low VOC type as defined by USGBC LEED-NC v4.0.

E. Additional Regulations: Follow additional regulations, which appear in individual Sections of these Specifications.

F. Contradictions: Where codes are contradictory, follow the most stringent, unless otherwise indicated in Plans or Specifications. Architect/Engineer shall determine which is most stringent.

G. Contract Documents Not in Compliance:

1. Where the Drawings and Specifications do not comply with the minimum requirements of the Codes, either notify the Architect/Engineer, in writing during the Bidding Period, of the revisions required to meet Code requirements, or provide an installation which complies with the Code requirements. After entering into contract, Contractor will be held to complete all work necessary to meet these requirements without additional expense to the Owner.
2. Follow Drawings and Specifications where they are superior to Code requirements.

H. Permits:

1. Obtain all permits required by authorities and agencies having jurisdiction for the work of this Division.
2. Post permits as required.

I. Tap and Connection Fees:

1. Pay fees charged by Utilities for making connections, bringing service to property line, or to meter and similar services.
2. Investment fees or plant development fees, which are charges levied by Utilities to cover the cost of the utility system to be borne by this project, are not part of the work of this Division.

J. Inspections and Tests:

1. Arrange for all required inspections and tests.
2. Pay all charges.
3. Notify Architect/Engineer 48 hours before tests.
4. Submit one copy for Owners records of permits, licenses, inspection reports and test reports.

K. LEED

1. This project will follow the guidelines and requirements of Leadership in Energy and Environmental Design (LEED). Provide all services and documentation required in this effort.
2. Commissioning: The project will have selected building systems commissioned as specified in Section 01810 – Commissioning. Coordinate pre-functional tests and start-up testing with commissioning.

1.7 RECORD DRAWINGS

A. General Recording Procedure:

1. Maintain a blue-line set of Divisions 21 through 23 Contract Drawings in clean, undamaged condition, for mark-up of installations, which vary, substantially from the Contract Drawings.
2. Record changes drawn to scale and fully dimensioned, as specified in Division 1.

a. Work concealed behind or within other work, in an inaccessible arrangement.
b. Mains and branches of piping systems:

1) with valves and control devices located and numbered.
2) with concealed unions located.
3) with items requiring maintenance located (traps, strainers, expansion compensators, tanks, etc.).

c. Underground piping and ducts, both exterior and interior.
d. Ductwork layouts, including locations of coils, dampers, filters, boxes and similar units.
e. Concealed control system devices and sensors.

B. Corrected Drawings:

1. Obtain a set of contract drawings on CAD.
2. Update the CAD files to reflect as-built conditions.
3. Transmit corrected CAD files and plots as a submittal to the Architect/Engineer for Owner’s use and record.

C. Temperature Control Drawings:

1. Indicate as-built conditions of work under this contract including:

a. Ladder wiring diagram.
b. Pneumatic schematic diagrams.
c. One line system diagram.
d. Control schematic of equipment with control devices located and identified.
e. Wiring or tubing termination diagrams.
f. List of materials.
g. Floor plan indicating all device locations.
h. Control sequences.
i. Indicate electrical power source for each point of connection to the electrical system.

2. Reproducible temperature control drawings shall be delivered to the Architect/Engineer prior to Owner’s acceptance of project.

1.8 CONTRACTOR REQUIREMENTS

A. A mechanical contractor bidding as prime contractor shall be a Maryland-licensed HVACR Master or Master Restricted contractor qualified in the areas of work included in the project.

B. The prime contractor shall agree to employ only individuals holding valid licenses issued by the State HVACR Board of the Department of Labor (DOL) to provide, or assist in providing, HVACR system installation or service required for the project.

C. If the prime contractor subcontracts any of the HVACR system installation or service required for a project, the subcontractor must possess appropriate licenses issued by DOL for the work to be performed. Employees of the subcontractor that provide or assist with HVACR system installations or service must hold appropriate licenses from DOL for the work being performed.

1.9 OPERATING AND MAINTENANCE DATA

A. Refer to Division 1 for additional requirements or the following:

B. Submission:

1. Submit typed and bound copies of Operating and Maintenance Manuals prior to scheduling systems demonstration for the Owner, as specified in Division 1.
2. Bind each Maintenance Manual in one or more vinyl covered, 3-ring binders, with pockets for folded drawings.

    a. Mark the back spine of each binder with system identification and volume number.

C. Required Contents:

1. Manuals shall have index with tab dividers for each major equipment section to facilitate locating information on specific piece of equipment.
2. Identify data within each section with drawing code numbers as they appear on Drawings and Specifications. Include as a minimum the following data:

    a. Alphabetical list of system components, with the name, address and 24 hour telephone number of the company responsible for servicing each item during the first year of operation. Include point of contact for company.
    b. Operating instructions for complete system including:

        1) Emergency procedures for fire and failure of major equipment.
        2) Major start, operation and shut-down procedures.

    c. Maintenance Instructions for each piece of equipment including:

        1) Equipment lists.
        2) Proper lubricants and lubricating instructions for each piece of equipment.
        3) Necessary cleaning, replacement and/or adjustment schedule.
        4) Product Data.
        5) Installation instructions.
        6) Parts lists.
        7) Complete wiring diagrams.

    d. Temperature control diagrams and O&M information as specified above (as-built).
    e. Marked or changed prints locating concealed parts and variations from the original system design (as-built drawings).
    f. Balancing Report.
    g. Valve schedule and associated piping schematics. See Division 23 05 53, Mechanical Identification.
    h. Copies of any extended equipment warranties, which are greater than one year.

1.10 WARRANTIES

A. The warranty period is two year after Date of Acceptance.

1. During this period, provide labor and materials as required to repair or replace defects in the mechanical system at no additional cost to the Owner. Provide certificate with O&M manual submittal which guarantees same-day service response to Owners call for all such warranty service.
2. Provide certificates for such items of equipment which have warranties in excess of one year. Insert copies in O&M manuals. Such equipment shall include:

a. Temperature Control Valves five (5) years.
b. Chiller compressors five (5) years.

3. Provide extended manufacturers warranties to cover one full year from date of acceptance if standard warranty starts any time prior to that date.
4. Provide factory trained service personnel for all warranty work on the DDC Control System and the following equipment:

a. Air cooled chiller.

B. Refer to Division 1 for additional requirements.

1.11 SCOPE

A. The Contractor shall:

1. Supply all labor, transportation, materials, apparatus, light, and tools necessary for the completion of the mechanical work.
2. Install, maintain, and remove all construction equipment.
3. Be responsible for safe, lawful, and proper construction maintenance.
4. Construct, in the best and most workmanlike manner, a complete project and everything properly incidental thereto, as shown on the Drawings, as stated in the Specifications, or reasonably implied therefrom, all in accordance with the Contract documents.

1.12 MANDATORY GOVERNING PROVISION

A. Omissions of words or phrases, such as “the Contractor shall,” “in conformity with,” “shall be,” “as noted on the Drawings,” “according to the Drawings,” “an,” “the,” and “all,” are intentional.

B. Omitted words or phrases shall be supplied by inference.

1.13 PROTECTION OF PROPERTY AND MATERIALS

A. Provide protection against dust migration, rain, wind, storms, frost, or heat, so as to maintain all work, materials, apparatus, and fixtures free from injury or damage.

B. At end of each day’s work, cover all new work likely to be damaged.

C. Do not interrupt the integrity of the building security overnight.

D. Refer to Division 1 for additional requirements.

1.14 OWNER FURNISHED EQUIPMENT

A. All equipment called out in the Specifications or shown on the Drawings as “Owner-Furnished Equipment” shall be installed and connected under this Contract. Provide rough-ins for all future connections indicated.

1.15 TEMPORARY FACILITIES

A. Light, Heat, Power, etc.

1. Responsibility for providing temporary electricity, heat and other facilities shall be as specified in Division 1.
2. Contractor shall be responsible for maintaining the equipment in an as-new condition. Equipment will not be turned over to the Owner until it is brought up to as-new condition.
3. The contractor shall be responsible for maintaining acceptable indoor air quality in adjacent occupied spaces.

B. Use of Permanent Building Equipment for Temporary Heating or Cooling.

1. Permanent building equipment shall not be used without written permission from the Owner. If this equipment is used for temporary heating or cooling, it shall be adequately maintained per manufacturer’s instructions and protected with filters, strainers, controls, reliefs, etc. The contractor shall protect all equipment and systems as directed by the engineer. The warranty period shall not start until the equipment is turned over to the Owner for their use. The contractor shall provide extended warranties for parts and labor for all such equipment. Equipment shall not be turned over to the Owner until the temperature controls have been tested and accepted by the Owner and Engineer.

1.16 INSTALLATION GENERAL REQUIREMENTS

A. Furnish, apply, install, connect, erect, clean, and condition manufactured materials and equipment as recommended in manufacturer’s printed directions (maintained on job site during installation).

B. Provide all attachment devices and materials necessary to secure materials together or to other materials.

C. Make allowance for ample and normal expansion and contraction for all building components and piping systems that are subject to such.

D. Install materials only when conditions of temperature, moisture, humidity, and conditions of adjacent building components are conducive to achieving the best installation results.

E. Erect, install, and secure components in a structurally sound and appropriate manner.

F. Where necessary, temporarily brace, shore, or otherwise support members until final connections are installed.

G. Leave all temporary bracing, shoring, or other structural supports in place as long as practical for safety and to maintain proper alignment.

H. Handle materials in a manner to prevent scratching, abrading, distortion, chipping, breaking, or other disfigurement.

I. Conduct work in a manner to avoid injury or damage to previously placed work.

J. Any work so impaired or damaged shall be replaced at no expense to Owner.

K. Fabricate and install materials true to line, plumb, and level.

L. Leave finished surfaces smooth and flat, free from wrinkles, warps, scratches, dents, and other imperfections.

M. Furnish materials in longest practical lengths and largest practical sizes to avoid all unnecessary jointing.

N. Make all joints secure, tightly fitted, and as inconspicuous as possible by the best accepted practice in joinery and fabrication.

O. Consult Engineer for mounting height or position of any unit not specifically indicated or located on Drawings or specified in Specifications.

P. Job mixed multi-component materials used in the work shall be mixed in such regulated and properly sized batches that material can be used before it begins to “set”.

Q. Mixing of a partially “set” batch with another batch of fresh materials will not be accepted and entire batch shall be discarded and removed from site.

R. Clean all mixing tools and appliances that can be contaminated prior to mixing of fresh materials.

S. In addition to the above refer to each Section of the Specifications for additional installation requirements for the proper completion of all work.

PART 2 - PRODUCTS

2.1 QUALITY CONTROL

A. Refer to Division 1 of the Specifications.

B. The manufacturer of equipment or materials listed on the drawings or specifically indicated in the specification is the basis of design. If the drawings and specifications are in conflict, the drawings shall take precedence. Other manufacturers listed are considered general equivalents only. See below for coordination of substitutions.

C. Products by manufacturers not listed in this Specification may be submitted to the Engineer, in writing, at least seven days before Bid Date.

1. Submittals will be reviewed for general equivalence only.
2. Approval for use in bidding will be issued by Engineer at least two days before Bid Date.
3. Products not considered to be general equivalents may not be bid.

D. Any manufacturer not listed shall be considered a substitution.

E. Items submitted as a substitution to the basis of design or listed general equivalents shall be identified as such and shall include a written request for substitution indicating the following:

1. Contract price adjustment.
2. Contract time adjustment.
3. Item by item breakdown of differences between basis of design and substituted item.
4. Operation, maintenance, and energy cost difference.

F. Coordination of general equivalents and substitutions: Where Contract Documents permit selection from several general equivalents, or where substitutions are authorized, coordinate clearance and other interface requirements with mechanical and other work.

1. Provide necessary additional items so that selected or substituted item operates equivalent to the basis of design and properly fits in the available space allocated for the basis of design.
2. Provide all features which are standard on the basis of design.
3. Contractor is responsible for assuring that piping, conduit, duct, flue, and other service locations for general equivalents or substitutions do not cause access, service, or operational difficulties any greater than would be encountered with the basis of design.

2.2 GENERAL SUBMITTAL REQUIREMENTS

A. Refer to Division 1.

B. Coordination and Sequencing:

1. Coordinate submittals 2 weeks (min.) prior to expected order date so that work will not be delayed by submittals.
2. No extension of time will be allowed because of failure to properly coordinate and sequence submittals.
3. Do not submit product data, or allow its use on the project until compliance with requirement of Contract Documents has been confirmed by Contractor.
4. Submittal is for information and record, unless otherwise indicated, and is not a change order request.
5. Submitting contractor is responsible for routing reviewed submittals to all parties affected including but not limited to electrical, temperature control, and test and balance subcontractors.

C. Preparation of Submittals:

1. Refer to Division 1 requirements.
2. Provide permanent marking on each submittal to identify project, date, Contractor, Subcontractor, Supplier, submittal name and similar information to distinguish it from other submittals.
3. Indicate any portions of work which deviate from the Contract Documents.

    a. Explain the reasons for the deviations.
    b. Show how such deviations coordinate with interfacing portions of other work.

4. Show Contractor’s executed review and approval marking.
5. Provide space for Architect’s/Engineer’s “Action” marking.
6. Submittals which are received from sources other than through Contractor’s office will be returned “Without Action”.

7. Submittals shall be presented in a neat and legible fashion and shall be returned “Without Action” if presented in any other fashion.
8. Submittals shall have index with tab dividers for each component to facilitate locating information on specific pieces of equipment and products.

D. Quantities: Unless otherwise indicated in Division 1, submit six copies.

1. Refer to Division 1 requirements.
2. Multiple System Items: Where a required submittal relates to an operation or item of equipment used in more than one system, increase the number of final copies as necessary to complete the Maintenance Manuals for each system.
3. Preliminary Submittal: Provide a preliminary, two-copy submittal for automatic temperature controls and when product data is required (or desired by Contractor) for selection of options by Architect/Engineer.
4. General Distribution:

    a. Provide additional distribution of submittals (not included in foregoing copy submittal requirements) to Subcontractors, Suppliers, Fabricators, Installers, Governing Authorities and others as necessary for proper performance of the work.
    b. Include such additional copies in transmittal to Architect/Engineer where required to receive “Action” marking before final distribution.

        1) Show such distributions on transmittal forms.

E. LEED Submittals:

1. Credit WE 3.1 and 3.2: Product Data for plumbing fixtures indicating water consumption. Prerequisite EA 3.0: Product Data for new HVAC equipment indicating absence of CFC refrigerants.
2. Credit EA 4.0: Product Data for new HVAC equipment indicating absence of HCFC refrigerants.
3. Credit EA 5.0: Product Data and wiring diagrams for sensors and data collection system used to provide continuous metering of building energy and water consumption performance over time.
4. Credit EQ 1.0: Product Data and Shop Drawings for carbon dioxide monitoring system and/or outdoor air monitoring station.
5. Credit EQ 3.1:

    a. Construction Indoor Air Quality (IAQ) management plan.
    b. Product Data for temporary MERV 8 filtration media.
    c. Construction Documentation: Six photographs at three different occasions during construction of the different SMACNA requirements along with a brief description of the SMACNA approach employed, documenting implementation of the IAQ management measures, such as protection of ducts, cleaning of air handling units, installation of filters, and on-site stored or installed absorptive materials.

6. Credit EQ 3.2:

    a. Signed statement describing the building air flush-out procedures including the dates when flush-out was begun and completed and statement that filtration media was replaced after flush-out.
    b. Product Data for MERV 8 filtration media used during flush-out.

c. Report from testing and inspecting agency indicating results of IAQ testing and documentation showing conformance with IAQ testing procedures and requirements.

7. Credit EQ 4.1: Product Data for adhesives and sealants used on the interior of the building indicating VOC content of each product used. Indicate VOC content in g/L calculated according to 40 CFR 59, Subpart D (EPA method 24).
8. Credit EQ 4.2: Product Data for paints and coatings used on the interior of the building indicating chemical composition and VOC content of each product used. Indicate VOC content in g/L calculated according to 40 CFR 59, Subpart D (EPA method 24).
9. Credit EQ 5: Product Data for MERV 13 filtration media used during occupancy.
10. Credit EQ 7.1: Product Data and Shop Drawings for sensors and control system used to monitor and control room temperature.

F. Response to Submittals: Where standard product data have been submitted, it is recognized:

1. That the Submitter has determined that the products fulfill the specified requirements.
2. That the submittal is for the Architect's or Engineer's information only, but will be returned with appropriate action where observed to be not in compliance with the requirements.

G. If more than two submissions (either for shop drawings, as-built drawings, or test and balance reports) are made by the contractor, the Owner reserves the right to charge the contractor for subsequent reviews by their consultants. Such extra fees shall be deducted from payments by the Owner to the contractor.

2.3 SPECIFIC CATEGORY SUBMITTAL REQUIREMENTS

A. Manufacturer's Data:

1. Where pre-printed data covers more than one distinct product, size, type, material, trim, accessory group or other variation, mark submitted copy with black pen to indicate which of the variations is to be provided.
2. Delete or mark-out significant portions of pre-printed data which are not applicable.
3. Where operating ranges are shown, mark data to show portion of range required for project application.
4. For each product, include the following:

a. Sizes
b. Weights
c. Speeds
d. Capacities
e. Piping and electrical connection sizes and locations.
f. Statements of compliance with the required standards and regulations.
g. Performance data.
h. Manufacturer's specifications and installation instructions.

B. Shop Drawings:

1. Prepare Mechanical Shop Drawings, except diagrams, to accurate scale.

a. Show clearance dimensions at critical locations.
b. Show dimensions of spaces required for operation and maintenance.
c. Show interfaces with other work, including structural support.

C. Test Reports:

1. Submit test reports which have been signed and dated by the firm performing the test.
2. Prepare test reports in the manner specified in the standard or regulation governing the test procedure (if any) as indicated.

D. Required equipment and shop drawing submittals:

1. Provide a submittal schedule with bid.
2. Provide equipment submittals for each item of equipment specified or scheduled in the contract documents.
3. Submittal Schedule shall show each item of equipment, applicable Section of the specifications where it is described, applicable Drawing number and schedule name where it is scheduled, date of Contractor's proposed submittal to Architect, required date to receive submittal from Architect and schedule order date.
4. Provide a Mechanical Shop Drawing Schedule for submission to the Architect with the Submittal Schedule. Refer to paragraph 1.3 -Coordination Within Divisions 21 through 23 above.
5. Review of shop drawings and product data by the Architect/Engineer, including any review annotations or stamp notations, does not relieve the contractor from the required compliance with the contract documents.
6. The shop drawing and product data review stamp notation requirements are defined as follows:

    a. "NO EXCEPTION TAKEN:" The reviewer did not observe any items which were not in compliance with the contract documents. All dimensions, details, and coordination with other trades are the responsibility of the contractor.
    b. "MAKE CORRECTIONS NOTED:" The reviewer indicated items observed that were not in compliance with the contract documents. The contractor shall not resubmit, but shall make corrections and provide corrected documents with the "Record Drawings."
    c. "REJECTED, REVISE AND RESUBMIT:" The reviewer indicated items observed which were not in compliance with the contract documents. The contractor shall resubmit showing corrections of all noted items. Delays for resubmittal do not relieve the contractor from meeting project schedules.
    d. "REJECTED:" The submission does not comply with the contract requirements. The entire submittal must be corrected and submitted for review. Delays for resubmittal do not relieve the contractor from meeting project schedules.

7. If shop drawings are submitted and returned as "NO EXCEPTION TAKEN" or "MAKE CORRECTIONS NOTED" and meet contract requirements, the contractor shall not resubmit any other shop drawings for these items.
8. If resubmittals are necessary, they shall be made as specified above for submittals. Resubmittals shall highlight all revisions made and cover shall include the phrase "RESUBMITTAL NO. _____."

    Resubmittal requirements do not entitle the Contractor to additional time and are not a cause for delay of the project.

2.4 COMPATIBILITY

A. General: Provide products which are compatible with other products of the mechanical work and with other work requiring interface with the mechanical work.

B. Altitude Ratings: Except where noted otherwise, all ratings and capacities stated in the Contract Documents are at the altitude of the project, not sea level. Project Altitude shall be considered to be 39 feet.

C. Power Characteristics:

1. For power characteristics of equipment supplied under Division 21 through 23 Sections, refer to the Sections of Divisions 26 through 28 and the Electrical Drawings for the power characteristics of each power-driven item of mechanical equipment.
2. Coordinate available power with Electrical Contractor before ordering equipment. Mechanical Contractor shall be responsible for ordering equipment to meet the available power characteristics.
3. See also Division 23 05 01 of these specifications.
4. If there is a conflict between Divisions 21 through 23 documents and Divisions 26 through 28 documents, alert the engineer. Do not order equipment prior to determining the proper electrical service. No contract cost adjustment will be allowed for equipment ordered in conflict with the available power characteristics.

2.5 SAFETY PROVISIONS

A. Equipment Nameplates: Provide power-operated mechanical equipment with a permanent nameplate attached by the manufacturer, indicating:

1. The manufacturer
2. Product name
3. Model number
4. Serial number
5. Speed
6. Capacity
7. Power characteristics
8. Labels of testing, listing, or inspecting agencies
9. Other similar data

B. Where manufacturer affixed nameplate is not available, Mechanical Contractor shall fabricate and attach nameplate.

C. Guards:

1. Unless equivalent guards are provided integral with the equipment, enclose each belt drive (including sheaves) on both side in a galvanized, one-inch, mesh screen of No. 18-gauge steel wire or expanded metal, fastened to an approved, structural steel frame, securely fastened to the equipment or floor.
2. Provide tachometer holes at shaft centers. Unless equivalent guards are provided integral with the equipment, install a solid guard of No. 20-gauge galvanized steel over the coupling of each item of direct-driven equipment.
3. Sides are not required on these guards except to ensure rigidity.

2.6 SAFETY PROVISIONS

A. Any refrigeration system containing CFC-11, CFC-12, HCFC-123, HCFC-22, or any of the other refrigerants listed in the Clean Air Act as a Class I or Class II Ozone Depleting Compound shall comply with the Clean Air Act and the Colorado Air Quality Control Commission Regulation #15.

B. As a minimum all systems shall be equipped with refrigerant recovery service valves, relief valves capable of resetting after activation, and for system with more than 50 pounds of charge, and isolateable receiver and/or condenser capable of holding the complete charge.

PART 3 - EXECUTION

3.1 COORDINATION OF MECHANICAL INSTALLATION

A. Inspection and Preparation:

1. Examine the work interfacing with mechanical work, and the conditions under which the work will be performed, and notify the Architect/Engineer of conditions detrimental to the proper completion of the work at original contract price.
2. Do not proceed with the work until unsatisfactory conditions have been corrected.

B. Layout:

1. Layout the mechanical work in conformity with the Contract Drawings, Coordination Drawings and other Shop Drawings, product data and similar requirements so that the entire mechanical plant will perform as an integrated system, properly interfaced with other work, recognizing that portions of the work are shown only in diagrammatic form.
2. Where coordination requirements conflict with individual system requirements, comply with the Architect's or Engineer's decision on resolution of the conflict.
3. Take necessary field measurements to determine space and connection requirements.
4. Provide sizes and shapes of equipment so the final installation conforms to the intent of the Contract Documents.

C. Integrate mechanical work in ceiling spaces with suspension system, light fixtures and other work so that required performances of each will be achieved.

3.2 PRODUCT INSTALLATION

A. Manufacturer's Instructions:

1. Except where more stringent requirements are indicated, comply with the product manufacturer's instructions and recommendations.
2. Consult with manufacturer's technical representatives, who are recognized as technical experts, for specific instructions on special project conditions.
3. If a conflict exists, notify the Architect/Engineer in writing, and obtain their instruction before proceeding with the work in question.

B. Movement of Equipment:

1. Wherever possible, arrange for the movement and positioning of equipment so that enclosing partitions, walls and roofs will not be delayed or need to be removed.

2. Otherwise, advise Contractor of opening requirements to be maintained for the subsequent entry of equipment.

C. Heavy Equipment:

1. Coordinate the movement of heavy items with shoring and bracing so that the building structure will not be overloaded during the movement and installation.
2. Where mechanical products to be installed on the existing roof are too heavy to be hand-carried, do not transport across the existing roof deck; position by crane or other device so as to avoid overloading the roof deck.

D. Return Air Path: Coordinate mechanical work in return air plenum to avoid obstructing return air path.

1. Do not make changes in layout which will reduce return air path cross-sectional areas. Minimum cross-sectional area will provide an average of 500 fpm and a maximum of 750 fpm velocity through return air plenum at specified supply air quantity unless otherwise noted.
2. Provide openings in any full height walls to allow for free movement of return air. Openings are to be sized for 500-750 fpm velocity. Notify the Architect/Engineer for any openings required in fire rated walls that are not shown on the contract drawings.
3. Report any obstructions by work of other Divisions to Architect/Engineer.

E. Clearances:

1. Install piping and ductwork:

   a. Straight and true.
   b. Aligned with other work.
   c. Close to walls and overhead structure (allowing for insulation).
   d. Concealed, where possible, in occupied spaces.
   e. Out-of-the-way with maximum passageway and headroom remaining in each space. In spaces without ceilings, mechanical systems are to be installed tight to the underside of structure. Sloping pipe runs must originate tight to structure to allow for maximum installed height throughout.

2. Except as otherwise indicated, arrange mechanical services and overhead equipment with a minimum of:

   a. 7’0” headroom in storage spaces.
   b. 8’6” headroom in other spaces, where approved by Architect.

3. Do not obstruct windows, doors or other openings.
4. Give the right-of-way to piping systems required to slope for drainage (over other service lines and ductwork).

F. Access:

1. Provide for removal, without damage to other parts, of:

   a. Coils
   b. Humidifier manifolds
   c. Tubes
   d. Shafts
   e. Fan wheels

f. Drives
g. Filters
h. Strainers
i. Bearings
j. Control components
k. Other parts requiring periodic replacement or maintenance

2. Connect equipment for ease of disconnecting with minimum of interference with other work.
3. Provide unions where required.
4. Locate operating and control equipment and devices for each access.
5. Provide access panels where units are concealed by non-accessible finishes and similar work. See Section 23 05 03.
6. Extend all grease fittings to an accessible location.

3.3 PROTECTION OF WORK

A. All pipe ends, valves, ducts, and equipment left unconnected shall be capped, plugged or otherwise properly protected to prevent damage or the intrusion of foreign matter.

B. Do not allow any fans in the HVAC system to operate before the area served by the fan has been cleaned and vacuumed of all debris and dust which might enter the system.

C. Any equipment, duct or piping systems found to have been damaged or contaminated above “MILL” or “SHOP” conditions shall be replaced or cleaned to the Engineer’s satisfaction.

D. Initial fill of traps:

1. Provide initial water seal fill for all waste P-traps, condensate traps, or similar traps.

3.4 PROTECTION OF POTABLE WATER SYSTEMS

A. All temporary water connections shall be made with an approved back flow preventer.

B. All hose bibs shall have as a minimum, a vacuum breaker, to prevent back flow.

C. Direct connections to hydronic systems shall only be made through a reduced pressure back flow preventer.

3.5 REFRIGERATION SYSTEMS

A. All techniques involved in the installation of refrigeration systems shall be certified and trained in accordance with any applicable State Codes and the applicable sections of the Clean Air Act.

B. No refrigerant shall be intentionally vented to the atmosphere. All refrigerant shall be recovered before opening a closed system for charging, evacuation, service or installation.

C. Refrigerants shall meet project LEED requirements.

3.6 START-UP

A. Assign a full time Divisions 21 through 23 Start-Up Coordinator to this project.

B. The Start-Up Coordinator shall develop detailed start-up procedures, equipment checkout procedures and data forms for recording compliance with contract document performance criteria, and will assist in developing schedules for checkout and Owner acceptance.

C. The Divisions 21 through 23 Contractor shall include as part of the work of this contract, manpower, equipment, tools, ladders, instruments, etc. necessary to confirm start-up of Divisions 21 through 23 systems.

D. The Division 23 05 93, Test, Adjust and Balancing Contractor shall include as part of the work of his/her contract, labor and material to provide manpower, equipment, tools, ladders, instruments, etc. necessary to assist the Start-Up Coordinator in accomplishing his/her work.

E. The Start-Up Coordinator shall be responsible for maintaining documentation of Start-Up activities until final acceptance of the project.

F. The documentation shall be kept current by the Start-Up Coordinator and shall be available for inspection at all times. At the time of acceptance of the project, the Start-Up Coordinator shall surrender 3 completed copies of the documentation to the Owner's representative.

G. Before Testing, Adjusting, Calibration and Balancing (Division 23 05 93), the Start-Up Coordinator shall confirm, in writing to the Owner, the following:

1. All equipment, components, and systems have been set, started-up, and adjusted.
2. Systems have been established at the appropriate temperatures and pressures for proper operation and performance.
3. All electric power connections, disconnects, fuses, circuit breakers, etc. are properly sized and installed.
4. The operation of all valves, dampers and sensors is positive (per the control sequences) and demonstrated.

H. Provide dated matrices for each item of equipment showing the date each of the start-up activities was witnessed or performed by the Start-Up Coordinator.

1. Start-up and operating performance test documentation shall include all Division 21 through 23 equipment with scheduled capacities and all Division 23 09 00 equipment.

I. At the completion of the start-up; and test and balance, Divisions 21 through 23 shall conduct a 72 hour dynamic mode demonstration of the systems in the presence of the Owner and Architect/Engineer.

3.7 DEMONSTRATION

A. Refer to Division 1 sections of the specifications regarding requirements of Record Drawings and Operation and Maintenance Manual submittal and systems demonstration.

1. Demonstrate to the Architect/Engineer that each system operates in accordance with the contract documents.
2. Explain the operation of each system to the Owner’s Representative. Explain use of O&M manual in operating and maintaining systems.

B. Date and time of demonstration will be determined by Owner.

3.8 PROJECT CLOSEOUT

A. Refer to the individual sections of the specifications for individual closeout requirements.

B. Provide all documentation required for LEED certification.

C. Provide a written schedule of when systems are to be started up, tested and demonstrated along with dates for completion of the temperature controls and balancing. This schedule shall be submitted no later than 30 days prior to starting up and testing equipment.

D. The contractor shall notify the Architect/Engineer no later than 2 weeks in advance of system testing or demonstration.

3.9 LEED

A. During construction meet or exceed the recommended Control Measures of the Sheet Metal and Air Conditioning National Contractors Association (SMACNA) IAQ Guidelines for Occupied Buildings under Construction, 1995, Chapter 3, as summarized below:

1. HVAC Protection – Use temporary heaters whenever feasible. Seal all duct and equipment openings with plastic. If permanently installed air handlers are used during construction, filtration media with a Minimum Efficiency Reporting Value (MERV) of 8, as determined by ASHRAE 52.2-1999, shall be used over each return air grille. Replace all filtration media immediately prior to occupancy. All leaks in ducts and air handlers should be repaired promptly.
2. Source Control – For Contractor information, all paints, carpet, caulks, adhesives, sealants are specified as low-VOC and non-toxic. Recover, isolate and ventilate containers housing toxic materials. Avoid exhaust fumes from idling vehicles and gasoline fueled tools.
3. Pathway Interruption – During construction, isolate areas of work to prevent contamination of clean or spaces. Ventilate using 100% outside air to exhaust contaminated air directly to the outside during installation of VOC emitting materials. Use pressure differentials or barriers between work and clean areas to prevent contaminated air from entering clean areas.
4. Housekeeping – Protect building materials from weather and store in a clean area prior to unpacking for installation. Clean all coils, air filters, and fans before performing testing and balancing procedures. Institute cleaning activities designed to control contaminants in building spaces.
5. Scheduling – Complete applications of wet and odorous materials such as VOCs in paints, sealants, and coatings before installing absorbing materials such as ceiling tiles, carpets, insulation, gypsum products, and fabric-covered furnishings. Avoid exposure of all interior materials to moisture.
6. Protect stored on-site or installed absorptive materials from moisture damage.

B. After construction ends, prior to occupancy and with all interior finishes installed, perform a building flush-out by supplying a total air volume of 14,000 cu.ft. of outdoor air per sq.ft. of floor area while maintaining an internal temperature of at least 60 degrees F and relative humidity no higher than 60%.

1. Contractors option: Either full continuous flush-out or air contaminant testing is required, not both,
2. For building flushout, perform building flush-out before occupancy and after construction is compete, HVAC systems have been tested, adjusted, and balanced, and new filtration media has been installed. Perform a building flush-out by supplying a total air volume of 14,000 cu.ft. of outdoor air per sq.ft. of floor area while maintaining an internal temperature of at least 60 degrees F and relative humidity no higher than 60%. If interior spaces must be occupied prior to completion of the flush-out, supply a minimum of 25% of the total air volume prior to occupancy and provide minimum outside air volumes of 0.30 cfm per square foot or design minimum outside air rate, whichever is greater. Install new HVAC filtration media after completion of flush-out and before occupancy or further testing. OR
3. For Air Contaminant testing, perform air contaminant testing prior to occupancy, after interior finishes are installed, HVAC system has been tested, adjusted, and balanced, and new HVAC filtration media has been installed. Collect indoor air samples representative of occupied areas. Collect samples at outside air intake of each air handler at the same time as indoor samples are taken. Analyze air samples and submit report. If air samples show concentrations higher than those specified, ventilate with 100% outside air and retest, or conduct full building flushout as specified above.
4. Air Contaminant Concentration Determination and Limits:

    a. Carbon monoxide: not more than 9 ppm and not more than 2 ppm higher than outdoor air.
    b. Formaldehyde: Not more than 50 ppb and not more than 20 micrograms per cubic meter higher than outside air.
    c. Total Volatile Organic Compounds: Not more than 500 micrograms per cubic meter and not more than 200 micrograms per cubic meter higher than outside air.
    d. 4-Phenylcyclohexene: Not more than 6.5 micrograms per cubic meter.
    e. Particulates: Not more than 50 micrograms per cubic meter.
    f. Total Particulates: Not more than 20 micrograms per cubic meter higher than outside air.

C. Construction waste management: Manage construction waste in accordance with provisions of Division 1. Submit documentation to satisfy the requirements of that section.

END OF SECTION

SECTION 23 05 03 - BASIC MECHANICAL MATERIALS AND METHODS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. This Section supplements Division 1, General Requirements.

B. Where contradictions occur between this Section and Division 1, the more stringent of the two shall apply. The design team shall decide which is more stringent.

C. Provisions of this Section shall also apply to all Sections of Divisions 21 through 23.

1.2 SUMMARY

A. Furnish and install complete electric heat tracing systems as specified herein and as indicated on the mechanical and plumbing drawings. Heat Trace systems shall be installed to maintain the product UL listing with strict conformance to manufacturer's installation requirements.

B. The Division 23 contractor shall be responsible for fully functional and complete heat trace systems. Refer to specification section 23 05 01 Mechanical and Electrical Coordination for heat trace system scope responsibility.

1.3 SUBMITTALS

A. Manufacturer's Data - Submit manufacturer's data for:

1. Access panels.
2. Fire stopping materials.

    a. Application Data - Submit application data for firestopping materials showing UL required installation details for every combination of pipe material, penetrated structure, opening size and required fire rating within the scope of this project. Application data drawings shall include UL system number.

3. Heat Trace.

    a. Submit shop drawings for review prior to installation. Shop drawings shall show the overall system, component product data, each control location, cable lengths, electrical connection requirements, and electrical feed points. Provide a summary sheet of the entire system with capacity data for each cable length.

B. LEED:

1. In addition to meeting the general requirements for VOC emissions, detailed in the LEED Reference Guide, on-site wet-applied products must not contain excessive levels of VOCs, for the health of the installers and other trades workers who are exposed to these products. To demonstrate compliance, a product or layer must meet the following requirements, as applicable. Disclosure of VOC content must be made by the manufacturer. Any testing must follow the test method specified in the applicable regulation.

    a. All paints and coatings wet-applied on site must meet the applicable VOC limits of the California Air Resources Board (CARB) 2007, Suggested Control Measure (SCM) for Architectural Coatings, or the South Coast Air Quality Management District (SCAQMD) Rule 1113, effective June 3, 2011.
    b. All adhesives and sealants wet-applied on site must meet the applicable chemical content requirements of SCAQMD Rule 1168, July 1, 2005, Adhesive and Sealant Applications, as analyzed by the methods specified in Rule 1168. The provisions of SCAQMD Rule 1168 do not apply to adhesives and sealants subject to state or federal consumer product VOC regulations.

PART 2 - PRODUCTS

2.1 ACCESS PANELS

A. See Division 8 for access panel types and finishes.

1. If panels are not specified in Division 8, comply with the following:

    a. Manufacturers:

        1) Acudor
        2) Karp Associates, Inc.
        3) Milcor
        4) Zurn.

B. Construction:

1. Doors: 14-gauge steel.
2. Frames: 16-gauge steel.
3. Fire Rating: Equivalent to construction in which installed.
4. Latches: Flush or concealed, ¼ turn.
5. Finish: Compatible with finish of construction in which installed.

2.2 FIRE STOPPING MATERIAL

A. Manufacturers:

1. Design Basis: 3M.

2. Other acceptable manufacturers:

    a. GE
    b. Metalines
    c. Hilti

B. General Requirements:

1. Products to be used shall have been tested in accordance with ASTM E 814-88, and be listed in the UL Fire Resistance Directory.

C. Bare Piping:

1. Model: FD 150, or CP-25.

D. Insulated Piping:

1. Model: CP-25 or FS-195, Intumescent.
2. “No-sag” or “self-leveling” as required.

E. Plastic Piping:

1. Model: CP-25 or FS-195, Intumescent.
2. “No sag” or “self-leveling” as required.

F. Accessories:

1. Provide fasteners, restricting collars, backing materials, and protective coatings as required to comply with the UL system listing.

2.3 ACOUSTICAL/PRESSURE SEALING MATERIAL

A. Manufacturers:

1. Manufacturers:

    a. D.A.P. Mono Acoustical Sealant
    b. GE
    c. Metacaulk
    d. Hilti
    e. Pecora
    f. Tremco
    g. U.S.G.

B. General Requirements:

1. Non-skinning, non-hardening synthetic butyl rubber.
2. Effective adhesive seal for air and vapor barrier.
3. Acceptable for use in air plenums.

C. Accessories:

1. Provide fasteners and backing rods as recommended by manufacturer.

2.4 HEAT TRACE FOR PIPING FREEZE PROTECTION IN WATER PIPING AND FIRE PROTECTION SYSTEMS

A. Manufacturers:

1. Design Basis: Raychem/Pentair.

    a. Model: XL-Trace

2. Other acceptable manufacturers:

    a. Chromalox
    b. Thermon
    c. Emerson/Nelson

B. General Requirements:

1. Intent of heat trace system is to prevent freezing of fluid inside piping.
2. For fire protection systems, this specification is applicable to fire protection supply lines and standpipes only.
3. Heat tracing system shall be designed to maintain the water temperature within the piping of at least 40ºF with an ambient temperature of -20ºF (60 ºF ΔT). The piping shall be insulated as specified in section 23 07 00 Mechanical Insulation.
4. Heat trace circuits shall be limited to a single piped utility only. Where multiple piped utilities in the same location are required to be heat traced, provide separately controlled circuits for each piped utility (i.e. domestic cold water, domestic hot water/recirculation, chilled water, etc. are each on separately controlled heat trace circuits). Domestic hot water and domestic hot water recirculation are allowed to be on the same heat trace circuit. Fire Sprinkler piping heat trace systems shall be dedicated to fire sprinkler piping only.

C. Heat Trace System Requirements:

1. Heating cables shall be UL listed and FM approved electrical heating strips. The electric heat tracing shall be a self-regulating type of parallel circuit construction consisting of a continuous inner core of self-regulating conductive material between two parallel copper bus wires suitable for operation on 277-Volt, 60 hertz, single phase power. Heat trace to be self-regulating at all points of connection and shall be capable of being overlapped or installed on plastic piping without overheating. The heat tracing strips shall be capable of being cut to the desired length in the field. Operating energy shall be conserved by the self-regulating feature of the heater materials, which automatically controls heat output in proportion to the heat requirement. Maximum operating temperature and exposure temperature shall be 150°F. Minimum installation temperature shall be 0°F.
2. The heat trace system shall include all required components for a fully functional system including heating cable, power connection, splice connections, tee connections, end seals, controls, contactors, power distribution panels, glass cloth adhesive tape, aluminum tape, accessories, and tools required for installation. Components shall be specific to the application (i.e. above ground or below ground), pipe material, and insulation type. Heat traced piping shall be labeled “Electric Traced” with permanent labeling. Provide one label per 10 feet of pipe.
3. Above ground piping:

    a. Provide polyolefin jacket on heat trace cables.

b. Non-fire protection systems: Heat Trace system shall be UL listed and FM approved for above ground general water piping freeze protection applications. Provide all components, connections, and accessories to maintain UL listing.
c. Fire protection supply lines: Heat Trace system shall be UL listed for above ground fire protection supply line freeze protection applications. Provide all components, connections, and accessories to maintain UL listing. Comply fully with NFPA 13.
d. Fire protection standpipes: Heat Trace system shall be UL listed for above ground fire protection standpipe freeze protection applications. Provide all components, connections, and accessories to maintain UL listing. Comply fully with NFPA 13.

D. Heat Trace Circuits:

1. Heat trace circuit quantity for 277V/1PH systems shall be based on maximum cable lengths below. All heat trace cabling shall be served by 20A GFEP circuit breakers. Where multiple cables are required, all cables may be on the same circuit as long as maximum total cable length is not exceeded. Tables below are based on the basis of design heat trace product installed on metallic or plastic piping with insulation as specified. For fluids over 200°F, provide insulation thickness per section 230700 Mechanical Insulation and select cabling as recommended by heat trace system manufacturer.

Heat Trace Circuits for Metallic Piping Systems with Fluids 200°F and less – 277V/1PH				
Pipe Size (Metallic Pipe)	Insulation Thickness	Design Heat Loss in Watts per linear foot	Cable Quantity and Power Output at 40°F Maintain Temperature and 60°F ΔT (Watts per linear foot)	Maximum Total Cable Length per circuit at -20°F startup temperature, 277V/1PH, 20A GFEP Circuit Breaker
½" and ¾"	1-1/2"	1.82 W/lf	(1) cable at 7.2 W/lf	245 ft.
1"	1-1/2"	2.06 W/lf	(1) cable at 7.2 W/lf	245 ft.
1-1/4"	2"	1.96 W/lf	(1) cable at 7.2 W/lf	245 ft.
1-1/2"	2"	2.18 W/lf	(1) cable at 7.2 W/lf	245 ft.
2"	2"	2.44 W/lf	(1) cable at 7.2 W/lf	245 ft.
2-1/2"	2"	2.8 W/lf	(1) cable at 7.2 W/lf	245 ft.
3"	2"	3.18 W/lf	(1) cable at 7.2 W/lf	245 ft.
4"	2"	3.8 W/lf	(1) cable at 7.2 W/lf	245 ft.
6"	2"	5.12 W/lf	(1) cable at 7.2 W/lf	245 ft.
8"	2"	6.34 W/lf	(1) cable at 7.2 W/lf	245 ft.
10"	2"	7.66 W/lf	(2) cables at 7.2 W/lf each	245 ft.
12"	2"	8.88 W/lf	(2) cables at 7.2 W/lf each	245 ft.
14"	2"	9.62 W/lf	(2) cables at 7.2 W/lf each	245 ft.
16"	2"	10.84 W/lf	(2) cables at 7.2 W/lf each	245 ft.
18"	2"	12.06 W/lf	(2) cables at 7.2 W/lf each	245 ft.
20"	2"	13.28 W/lf	(2) cables at 7.2 W/lf each	245 ft.

Heat Trace Circuits for Plastic Piping Systems with Fluids 200°F and less – 277V/1PH				
Pipe Size (Plastic Pipe)	Insulation Thickness	Design Heat Loss in Watts per linear foot	Cable Quantity and Power Output at 40°F Maintain Temperature and 60°F ΔT (Watts per linear foot)	Maximum Total Cable Length per circuit at -20°F startup temperature, 277V/1PH, 20A GFEP Circuit Breaker
½" and ¾"	1-1/2"	1.82 W/lf	(1) cable at 5.4 W/lf	245 ft.
1"	1-1/2"	2.06 W/lf	(1) cable at 5.4 W/lf	245 ft.
1-1/4"	2"	1.96 W/lf	(1) cable at 5.4 W/lf	245 ft.
1-1/2"	2"	2.18 W/lf	(1) cable at 5.4 W/lf	245 ft.
2"	2"	2.44 W/lf	(1) cable at 5.4 W/lf	245 ft.
2-1/2"	2"	2.8 W/lf	(1) cable at 5.4 W/lf	245 ft.
3"	2"	3.18 W/lf	(1) cable at 5.4 W/lf	245 ft.
4"	2"	3.8 W/lf	(1) cable at 5.4 W/lf	245 ft.
6"	2"	5.12 W/lf	(1) cable at 5.4 W/lf	245 ft.
8"	2"	6.34 W/lf	(2) cables at 5.4 W/lf each	245 ft.
10"	2"	7.66 W/lf	(2) cables at 5.4 W/lf each	245 ft.
12"	2"	8.88 W/lf	(2) cables at 5.4 W/lf each	245 ft.
14"	2"	9.62 W/lf	(2) cables at 5.4 W/lf each	245 ft.
16"	2"	10.84 W/lf	(2) cables at 8.1 W/lf each	194 ft.
18"	2"	12.06 W/lf	(2) cables at 8.1 W/lf each	194 ft.

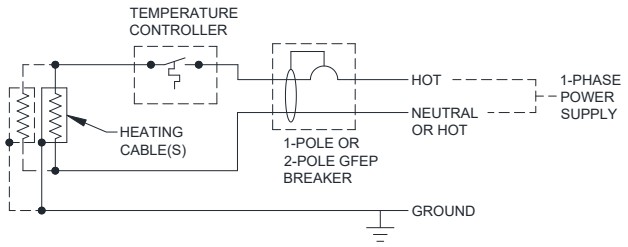
Heat Trace Circuits for Plastic Piping Systems with Fluids 200°F and less – 277V/1PH				
Pipe Size (Plastic Pipe)	Insulation Thickness	Design Heat Loss in Watts per linear foot	Cable Quantity and Power Output at 40°F Maintain Temperature and 60°F ΔT (Watts per linear foot)	Maximum Total Cable Length per circuit at -20°F startup temperature, 277V/1PH, 20A GFEP Circuit Breaker
20”	2-1/2”	10.94 W/lf	(2) cables at 8.1 W/lf each	194 ft.

Adjust heat trace cabling power output and circuit quantity as required for design voltage, piping material, insulation type, insulation thickness, and selected manufacturer’s maximum cable lengths.

E. Controls and Power Distribution:

1. Each heat trace circuit shall be served by a dedicated heat trace controller

   a. Provide microprocessor-based single-point heat trace electronic controller with programmable keypad and integral ground-fault protection. Basis of design: Raychem C910-485.
   b. Controller shall include internal trip functionality and shall comply fully with the NEC.
   c. Controller shall be NEMA 4X rated with ambient operating temperature range of -40°F to 140°F and relative humidity range of 0% to 90% non-condensing.
   d. Controller shall include local LED indicator lights to indicate when heater is on and when an alarm condition exists.
   e. Controller shall include an isolated solid-state triac relay and a dry contact relay for alarm annunciation.
   f. Controller shall be provided with Modbus RTU serial communication interface for communication with Division 230900 BMS.
   g. Controller shall be capable of detecting and reporting a ground fault, ambient temperature or piping temperature, and system current. Controller shall automatically conduct periodic testing of system for faults and shall alert the BMS when a fault is detected.
   h. Controller shall be wired in a single circuit control configuration with the controller mounted in series with the heating cable. Wiring shall be per manufacturer’s recommendations.
   i. Total heat trace circuit capacity may not exceed the current rating of the heat trace controller.
   j. Power Wiring Diagram:



2. Control Methodology:

   a. Provide 3-wire 100-ohm platinum resistance temperature detector (RTD) for ambient-sensing control of heat trace system.
   b. RTD to be installed in same space as heat traced piping and wired to heat trace controller per manufacturer’s recommendations. RTD shall measure ambient air temperature near heat traced piping system. Where system is larger than 75 linear

feet, provide two RTDs wired to heat trace controller and mounted at the 1/3 and 2/3 distances of the heat traced piping run.

c. For heat trace installed on fire protection piping systems: Provide wired connection from heat trace controller to fire alarm control panel for alarm indication to fire alarm system. Comply fully with NFPA 13.

PART 3 - EXECUTION

3.1 EXCAVATION

A. Quality Coordination: Where excavation and backfill for mechanical work passes through or occurs in the same area as work specified in Division 2, comply with both the requirements of Division 2 and the requirements of this Section, or whichever is the more stringent (as determined by the Architect/Engineer in cases of conflicting requirements).

B. Inspection:

1. Examine the areas to be excavated, and the conditions under which the work is to be performed.
2. Notify the Architect/Engineer in writing of conditions detrimental to the proper completion of the work.
3. Do not proceed with excavating until unsatisfactory conditions have been corrected.

C. General:

1. Do not excavate for mechanical work until the work is ready to proceed without delay, so that the total time lapse from excavation to completion of backfilling will be minimum.
2. Remove all rock and boulders from excavation before installing mechanical work.
3. Slope sides of excavations as required for stability, or provide necessary shoring.
4. Remove shoring during backfilling.
5. Excavate near large trees (within the drip line) by hand.

    a. Protect the root system from damage or drying to the greatest extent possible.
    b. Maintain moist condition for root system and cover exposed roots with burlap.
    c. Paint root cuts of 1” diameter and larger with asphaltic tree paint.

6. Saw-cut asphalt and concrete surfaces.

D. Protection:

1. Provide temporary covering or enclosure and temporary heat as necessary to protect bottoms of excavations from freezing and frost action. Do not install mechanical work on frozen excavation bases or subbases.
2. Coordinate excavations with weather conditions, to minimize the possibility of washouts, settlements and other damages and hazards.
3. Allow no more than 100 feet between pipe laying and point of complete backfilling.
4. Maintain dry excavations for mechanical work by removing water.

    a. Protect excavations from inflow of surface water.
    b. Pump minor inflow of ground water from excavations.
    c. Protect excavations from major inflow of ground water by installing temporary sheeting and waterproofing.

d. Provide adequate barriers which will protect other excavations and below-grade property from being damaged by water, sediment or erosion from or through mechanical work excavations.

5. Provide signs, illumination and barricades as necessary to prevent accidents at excavations.
6. Install and operate a well-point dewatering system to maintain ground water at a level approximately 2'0" below mechanical work excavations, until backfilling is completed.

E. Excavated Material:

1. Store excavated material (temporarily) near the excavation, in a manner which will not interfere with or damage the excavation or other work. Do not store under trees (within the drip line).
2. Retain excavated material which complies with the requirements for backfill material.
3. Remove excavated material which is either in excess of quantity needed for backfilling or does not comply with requirements for backfill material from project site, and dispose of in a lawful manner.
4. Coordinate acceptable stockpiling areas with Owner in advance of excavation.

F. Bedding:

1. Where indicated below, install as bedding material graded sand with 100% passing through a 3/8" sieve, and 0% passing through No. 100 sieve.

   a. Compact by tamping to form a firm base for the work.
   b. Install bedding from six inches below bottom of pipe to six inches above top of pipe.
   c. Provide bedding for:

      1) Wrapped, coated or plastic pipe and tanks.
      2) Piping over six inches, horizontal cylindrical tanks, and similar work.

         a) Shape the subbase to fit the shape of the bottom 90º of the cylinder, for uniform continuous support.

      3) All water and sewer pipe.

2. Where rock is used as sub-base, place 8-mil polyethylene between rock and bedding.
3. Shape sub-bases and bottoms of excavations with recesses to receive pipe bells, flange connection, valves and similar enlargements in the piping systems.

G. Concrete Encasement: Where piping under roadways is less than 2'6" below surface of roadway, or where ductwork is buried below grade:

1. Provide 4" base slab of concrete to support piping and ductwork.
2. After piping or ductwork is installed and tested, provide 4" thick encasement (sides and top) of concrete before backfilling.

   a. Provide external structural reinforcing of all rectilinear cross section ductwork or any ductwork which is less than 18 ga sheet metal (or equivalent) to prevent collapse of ductwork encasement.

3. Provide minimum 2500 psi concrete for encasement and slab.

H. Backfilling:

1. Do not backfill until installed mechanical work has been tested and accepted, wherever testing is indicated.
2. Condition backfill material by either drying or adding water uniformly, to whatever extent may be necessary to facilitate compaction to the required densities.
3. Do not backfill with frozen soil materials.
4. Backfill simultaneously on opposite sides of mechanical work, and compact simultaneously.
5. Do not dislocate the work from installed positions.
6. Backfill to elevations matching adjacent grades, at the time of backfilling excavations for mechanical work.
7. Backfill with finely graded sub-base material to 6” above wrapped, coated, and plastic piping and tanks, and to centerline of other tanks.
8. Backfill excavations in 8” high courses of backfill material, uniformly compacted to the densities indicated in Division 2 using power-driven, hand-operated compaction equipment.
9. If densities are not indicated in Division 2, compact to the following percent of maximum per ASTM D1557:

    a. Lawn/Landscaped Areas: 85%.
    b. Paved Areas, Other than Roadways: 90%.
    c. Roadways: 95%.
    d. Floors: 95%.

10. Where compaction tests indicate lower densities of backfill than specified, continue compaction (and re-excavation and backfilling where necessary).

    a. Provide additional testing as directed by the Architect/Engineer.
    b. The allowable density tolerance is not more than one-test-out-of-five failing more than two percentage points below the specified density.
    c. Initial testing is not work of this Section.

11. Where subsidence is measurable or observable at mechanical work excavations during the guarantee period:

    a. Remove the surface (pavement, lawn or other finish).
    b. Add backfill material, compact, and replace the surface treatment.
    c. Restore the appearance, quality and condition of the surface or finish to match adjacent work.
    d. Eliminate evidence of the restoration to the greatest extent possible.

I. Landscape Restoration:

1. Where excavation and backfill for mechanical work passes through or occurs in a landscaped area, repair or replace the landscape work to match the original condition and quality of the work.
2. Comply with the requirements of Division 2 for repair or replacement of work, and for follow-up maintenance on lawns and planting to ensure satisfactory recovery.

J. Pavement Restoration:

1. Where excavation and backfill for mechanical work passes through or occurs in an area of paving or flooring, replace and restore the construction and finish of the paving or flooring to match the original condition and quality of the work.

K. Surface Repairs:

1. The repairing and replacing of previously installed landscape development work, paving, floor slabs and similar finishes occurring in excavated areas shall be provided, but is not included in work of Divisions 21 through 23.

3.2 CUTTING AND PATCHING

A. Refer to Division 1 of the Specifications.

B. General: Provide measurements, drawings and layouts to installers of other work so that required openings may be provided as construction progresses. Any cutting and patching made necessary by failure to provide this information shall be done at no increase in the contract amount.

C. General: All cutting and patching of existing work required for work of Divisions 21 through 23 is included in Divisions 21 through 23. Cutting and patching is not work of Divisions 21 through 23, except as provided in Article 3.2 A. of this Section.

D. Where possible, mark openings to be cut on existing construction. Otherwise, provide measurements, drawings and layouts to the trade doing the cutting so that openings may be provided as construction progresses.

E. Cutting Concrete:

1. Where authorized, cut openings through concrete for pipe penetration and similar services by core drilling or sawing.
2. Do not cut by hammer-driven chisel or drill.

F. Cutting:

1. Cut openings in accordance with layouts, measurements, or drawings of the Installer of work requiring openings. Cut openings in concrete by core drilling or sawing; not by hammer-driven chisel or drill.
2. Coordinate the location of all openings with structural drawings. Report any discrepancies to Architect. Do not proceed with work until discrepancies have been resolved.
3. Do not endanger or damage other work through the procedures and processes of cutting to accommodate mechanical work.
4. Review the proposed cutting with the Installer of the work to be cut and comply with their recommendations to minimize damage.
5. Where necessary, engage the original Installer or other specialists to execute the cutting in the recommended manner.

G. Patching:

1. Where patching is required to restore other work because of either cutting or other damage inflicted during the installation of mechanical work, engage experienced craftsmen to complete the patching of the other work.
2. Restore the other work in every respect, including the elimination of visual defects in exposed finishes.
3. All openings in fire rated construction shall be patched and sealed with U.L. approved sealant to maintain the fire integrity of the structure.

H. Perform cutting, and patching required to:

1. Uncover work to provide installation of ill-timed work.
2. Remove and replace defective work.
3. Remove and replace work not conforming to requirements of the Contract Documents.
4. Remove samples of installed work as specified for testing.
5. Install equipment and materials in existing structures.
6. Upon written instructions from the Architect/Engineer, uncover and restore work to provide for Architect/Engineers observation of concealed work.

I. Painting: Paint all surfaces marred by cutting and/or patching to match existing.

1. Engage experienced painters.
2. Comply with requirements of Painting Sections of this Specification.

J. Structural Limitations:

1. Do not cut or drill into structural framing, walls, floors, decks, and other members intended to withstand stress, except with Engineer's written authorization.

    a. Provide lintels, columns, braces and other temporary and permanent supports made by cutting.
    b. Submit shop drawings of permanent supports.
    c. Do not penetrate legs of structural "T's" or any other location where pre-stressed structural chords are likely to be encountered when cutting or drilling.

3.3 ACCESS PANELS

A. Furnish access panels where indicated and at locations where required for access to:

1. Concealed valves
2. Dampers
3. Control devices
4. Equipment servicing
5. Shock arresters
6. Air vents
7. Flow measuring and balancing stations
8. Any other device or item equipment requiring maintenance, adjustment or service.

B. Deliver access panels for installation by the trade responsible for surface in which installed.

1. Provide instructions for location.
2. Access doors shall be sized as required to allow equipment removal, with a minimum size of 12"x12".

3.4 SLEEVES

A. Provide sleeves for piping passing through walls, floors and roofs.

B. Set pipe sleeves and inserts in place before concrete is poured. Coordinate the placing of these items to avoid delaying concrete placing operations.

C. Locate chases, shafts, and openings required for the installation of the mechanical work during framing of the structure. Do any additional cutting and boring required due to improperly located

or omitted openings without cost to the Owner under the supervision of the Owner's representative.

D. Size sleeves for below grade pipe a minimum of 2" beyond outside of pipe.

E. Provide Sleeves as Follows:

Sleeve Location	Sleeve Material
Interior Stud Partition Walls	Adjustable galvanized sheet metal with wall flanges and plaster lip, 2" and smaller – 22 gauge, 3" through 6" – 20 gauge, 8" and larger – 18 gauge.
Membrane Waterproof Floor and Roof Construction	Galvanized cast iron body with flashing clamp, threaded for sleeve riser. (J.R. Smith 1760 or equivalent by Ancon, Zurn or Josam).
Nonmembrane Floor, Construction	Non-adjustable galvanized sheet metal with deck flange and end cap, 2" and smaller – 22 gauge, 3" – 20 gauge, 4" and larger – 16 gauge.
Exterior Walls Below Grade	Standard weight galvanized steel pipe with a continuously welded water stop of ¼" steel plate extending from outside of sleeve a minimum of 2" all around. Provide modular mechanical–type seal consisting of interlocking synthetic rubber links with bolts shaped to continuously fill the annular space between the pipe and sleeve. Thunderline Corporation "Link-Seal" sealant assembly or equal by Metraflex "MetaSeal".
Floors of Mechanical Rooms, Concrete Walls or Masonry Walls Above Grade.	Standard weight galvanized steel pipe.

F. Length of Sleeves as Follows:

Location	Sleeve Length
Floors	Equal to depth of floor construction including finish. Extend minimum of 1" above finished floor level within partitions, mechanical rooms, pipe chases and finished areas.
Roofs	Equal to depth of roof construction including insulation.
Walls	Equal to depth of construction.

3.5 FIRE STOPPING

A. Install firestopping materials in accordance with their UL and ASTM tested methods.

B. Coordinate required annular space with size of pipe and sleeve. Refer to Section 23 05 22.

C. Requirements for specific systems:

1. Cold piping - includes chilled water, domestic water, storm water and refrigerant: Insulation and vapor barrier shall be continued through wall and firestopping for "insulated piping" shall be provided.
2. Hot piping - to 250ºF -includes domestic hot water, steam to 15 psig and heating hot water: The Contractor has the option of continuing the insulation through the penetration and providing firestopping for "insulated piping", or stopping the insulation on either side of the penetration and using firestopping for "uninsulated piping".

3. High temperature piping, over 250ºF or over 15 psig steam: Contractor shall stop insulation and provide firestopping for “high temperature piping”.

3.6 HEAT TRACE

A. Furnish and install a complete electric heating cable system as indicated on the mechanical and plumbing drawings.

B. Heat trace cable shall be installed by a licensed electrician.

C. Heat trace systems shall be installed per manufacturer’s requirements in order to maintain system agency listings.

D. Minimum installation temperature shall be 0°F. Do not apply heat trace when pipe temperature, roof temperature, gutter temperature, or downspout temperature is below 0°F.

E. Apply the heat trace cable on the pipe after pressure testing.

1. Do not spiral wrap on pipe.
2. Make one wrap at valves.
3. Secure to pipe with methods approved by manufacturer.

F. Apply “Electrically Traced” signs on outside of insulation for heat traced piping. Provide one sign for every 10’ of pipe length.

G. Heating cable circuit integrity shall be tested using a 2500 VDC megohmmeter at the following intervals. Minimum acceptable insulation resistance shall be 1000 megohms or greater.

1. Before installing the heating cable
2. After heating cable has been installed onto the pipe
3. After installing connection kits
4. After the thermal insulation is installed onto the pipe
5. Prior to startup

H. Heat trace shall be sized based on the application, and power shall be provided in accordance with manufacturer’s recommendations for circuit quantity and power distribution.

I. Do not locate heat trace controllers in Class 1, Division 2 hazardous areas.

J. Startup shall be conducted by manufacturer’s representative.

3.7 EQUIPMENT BASES AND SUPPORTS

A. Supporting Steel: Provide supporting steel not indicated on the Structural Drawings for equipment, pipe, ductwork, and other pieces of this Division’s work requiring same.

1. Submit shop drawings and structural calculations to the Engineer for information and records.
2. Brace and fasten with flanges bolted to structure.
3. Paint supporting steel with one coat of primer paint in the shop after fabrication welding is complete. Paint completed field joints with one coat of matching primer.

B. Housekeeping Bases:

1. Concrete bases for pumps, boilers, tanks, fans, etc., including anchor bolts and inserts, will be provided in accordance with American Concrete Institute (ACI) and American Society for Testing and Materials (ASTM) Standards for housekeeping pads and equipment support bases.
2. The concrete shall be placed in accordance with setting diagrams and sizes furnished by the equipment installer.

C. Roof Curbs

1. All roof-mounted equipment to be provided with a roof curb in accordance with applicable codes and manufacturer's installation instructions. Height of curb to be a minimum of 14" or higher if required by local codes.
2. Curb height is defined as the dimension between finished roof level (inclusive any buildup of insulation, roofing materials, etc.) and the bottom of the associated equipment.

3.8 DRIP PANS

A. Drip Pans: Where possible to run mechanical piping elsewhere, do not run mechanical piping directly above electrical (or electronic) work which is sensitive to moisture. Otherwise, provide drip pans under mechanical piping, sufficient to protect electrical work from dripping.

1. Locate pan immediately below piping, and extend a minimum of 6" on each side of piping and lengthwise 18" beyond equipment being protected.
2. Fabricate pans 2" deep of reinforced sheet metal with rolled edges and soldered or welded seams; 22-gauge galvanized steel.
3. Provide ¾" copper drainage piping from pan to nearest floor drain or similar suitable point of discharge, and terminate pipe as an open-sight drainage connection.
4. Provide permanent support and anchorage to prevent displacement of drip pans.
5. Insulate bottom of pan as directed by Engineer.

3.9 LEED

A. Construction Indoor Air Quality Management: Manage indoor air quality in accordance with applicable LEED requirements.

B. Construction Waste Management and Disposal: Manage construction waste in accordance with applicable LEED requirements.

C. Paints and coatings must comply with Green Seal Standard GS-11, Green Seal Standard GC-03, and South Coast Air Quality Management District Rule 1113.

END OF SECTION

SECTION 23 05 04 - CORROSION PROTECTION FROM HUMID SALT-LADEN OUTDOOR AIR

PART 1 - GENERAL

1.1 SCOPE

A. This specification covers materials and application methods for maximum corrosion resistance for HVAC equipment located outdoors, including rooftops, or otherwise exposed to outdoor air.

1.2 QUALITY CONTROL

A. Work under this section shall be observed by an authorized representative of the coating materials manufacturer, who shall provide recommendations on execution of the work, and at the conclusion of the work, shall state in writing that, to the best of their knowledge and belief, the work was performed in accordance with this specification and their recommendations.

1.3 SUBMITTALS

A. Manufacturer’s Data: Submit manufacturer’s product data including:

1. Conformance to SSPC and AWWA specifications.
2. Resistance qualities to humid salt-laden air.
3. Installation instructions.

B. Applicator’s Data: Submit a statement of material applicator’s experience and qualifications.

1.4 SURFACE PREPARATION

A. Proper surface preparation is mandatory. If evidence of rust or scaling exists on new ferrous steel surfaces removed it shall be in accordance with SSPC-SP-2 (Steel Structures Painting Council-Specification -2) Hand Tool Cleaning, SSPC-SP-3 Power Tool Cleaning, or SSPC-SP-6 Commercial Blast Cleaning. The choice of surface preparation shall be consistent with the degree of corrosion present, and surface preparation shall be in accordance with recommendations of the coating manufacturer’s representative prior to start of work.

B. Non-ferrous, extended surface heat exchangers (finned coils), shall be cleaned in accordance with SSPC-SP-1 Solvent Cleaning. Solvent shall be as recommended by coating manufacturer and be compatible with subsequently applied coatings.

PART 2 - PRODUCTS

2.1 NON-FERROUS HEAT EXCHANGER FINNED SURFACES (TYPE 1)

A. Material shall be vinyl copolymer designed for protection of aluminum, copper, galvanized and steel surfaces. It shall be particularly resistant to salt spray and resistant to a wide range of chemicals. The coating shall provide a tough, flexible, highly abrasion-resistant surface that is easy to repair.

1. Vinyl copolymer shall conform to AWWA Specification D-102 and Steel Structures Painting Council Paint Specification PS-4.02-64T.
2. Vinyl copolymer shall have a volume of solids per ASTM D2697 of 23.46%. The low volume of solids is essential to proper fog spray application. Higher solids materials, even when thinned, may adversely affect performance of coating system. Color shall be gray.
3. Vinyl copolymer shall be applied fog coated in multiple passes to a maximum dry film thickness of 3 mils. No primer or material except recommended solvent shall be used in conjunction with the specified vinyl copolymer.

2.2 FERROUS, GALVANIZED AND ALUMINUM SURFACES (TYPE 2)

A. Primer material shall be a polyamide cured epoxy primer. Volume of solids per ASTM D2697 shall be 47 $\pm$ 3%. Manufacturer's product data sheets shall indicate suitability for application on newly galvanized, weathered galvanized, aluminum or zinc-primed surfaces. Primer material shall be by the same manufacturer as vinyl copolymer.

PART 3 - EXECUTION

3.1 EQUIPMENT TO BE PROTECTED

A. Roof-mounted cooling units (Air Cooled Chiller): Provide type 1 application to all condenser and evaporator coils of all RTUs. This coating shall be as an add alternative to the base contract price and shall be addressed in the bid price of Section 23 74 00.

B. Roof-mounted units (Fans): Provide type 2 application to all rooftop exterior casing exposed to outside air. This coating shall be as an add alternative to the base contract price and shall be addressed in the bid price of Section 23 74 00.

3.2 APPLICATORS

A. Since coatings specified herein are of a specialized nature it is essential that only qualified and experienced applicators perform this work. A clean area, specialized equipment, and experience in fog coating and spraying procedures are required to properly apply coating without defects.

3.3 ACCESS FOR COATING WORK

A. The entire apparatus (unit) being coated shall be disassembled to the maximum degree without disturbing wiring or piping. Upon completion of coating work, the apparatus (unit) shall be re-assembled with care being taken to not damage coatings.

3.4 COILS

A. For non-ferrous, extended surface heat exchangers (fin coils), the coating shall be sprayed uniformly and completely over all surfaces on the fins and tubes. This will require several passes over each side of the coil in order to achieve effective penetration through the inner coil rows without excessive film build-up on the fin edges. Coating shall not be over-applied. Application rate as specified is designed to minimize impairment to heat exchange capability. Coating viscosity shall be properly adjusted to compensate for temperature and humidity conditions at the time of application.

3.5 SURFACES OTHER THAN COILS

A. Epoxy primer shall be applied to a dry film thickness of 2 mils. Drying time before top coating with vinyl copolymer shall be a minimum of 4 hours. Maximum interval before topcoat application shall be 24 hours.

B. Application of vinyl copolymer topcoat shall be in two coats, to achieve a total dry film thickness of 3 mils.

C. Total thickness of coating system on these surfaces shall be a minimum of 5 mils dry film thickness.

3.6 TOPCOATING OF FACTORY COATED FERROUS, GALVANIZED AND ALUMINUM SURFACES

A. Primer coat shall be applied over existing factory coated surfaces only when existing surface conditions such as corrosion, flaking, and peeling would interfere with the proper adhesion and bonding of the vinyl copolymer topcoat. If primer is required, prepare surfaces according to appropriate SSPC Cleaning standard specified hereinbefore. Apply primer as recommended by manufacturer of vinyl copolymer for such conditions.

3.7 REPAIR AND DAMAGED SURFACES

A. After each item of equipment has been installed, exterior surfaces shall be inspected and all damage to coatings shall be repaired by priming if required followed by top coating, applied by brush or roller.

END OF SECTION

This page is intentionally left blank.

SECTION 23 05 13 - MOTORS AND STARTERS

PART 1 - GENERAL

1.1 SUBMITTALS

A. Submit manufacturer's product data.

1. Motors: Identify by unit served. Include:

   a. Voltage
   b. Phase
   c. Horsepower
   d. Frame
   e. Insulating class
   f. Efficiency
   g. Power factor
   h. Index number
   i. Speed
   j. Starting characteristics

2. Starters: Identify by motor served. Include:

   a. Enclosure, NEMA Type
   b. NEMA size
   c. Accessories, switches, transformers, etc.
   d. Wiring diagram
   e. Auxiliary contacts
   f. Thermal overload size

3. Submit as part of packaged unit submittals when purchased as part of item of equipment.

1.2 SINGLE MANUFACTURER

A. Provide all motors, except those factory mounted, by a single manufacturer.

B. Provide all starters, except those factory mounted, by a single manufacturer.

C. "Factory mounted" means "as part of a packaged unit" where the motor is not purchased separately from the driven equipment.

PART 2 - PRODUCTS

2.1 MOTORS (OTHER THAN FACTORY MOUNTED)

A. Manufacturers:

1. Manufacturers:

a. Century
b. General Electric
c. Louis Allis
d. U.S. Motor
e. Westinghouse

2. Factory-mounted motors may be by equipment manufacturer's standard supplier.

B. Bearings: Ball bearings, grease lubricated with grease fittings.

C. Enclosure: As required by location.

D. Service Factor: 1.15.

E. Full-Load Operation: At 105ºF and altitude of project.

F. Insulation:

1. Constant Speed: Class B.
2. Variable Frequency Controlled: Class F.

G. Efficiency Ratings:

1. All motors one horsepower and larger, except as noted, shall be premium efficiency motors, in accordance with NEMA Standard MGI-2003, Tables 12-12 and 12-13.

H. Electrical Characteristics:

1. Refer to sections 230501, Mechanical and Electrical Coordination.
2. Motors smaller then ½ hp shall be 115-Volt single phase.
3. Motors ½ hp and larger shall be three phase, of voltage shown in Electrical Section of Contract Documents.

I. Multi-speed Motors:

1. Type: Motors may be one of the following:

a. Two speed, two winding 1800/900 rpm.
b. Two speed, one winding 1800/900 rpm.

J. Variable Speed Drives:

1. All motors operated by a variable speed drive shall be rated for inverter duty.
2. Motor insulation shall be rated for 1200-Volt peak.
3. Provide shaft grounding Aegis SGR or equal on motors to be used with variable speed drives.

2.2 MOTORS (FACTORY MOUNTED)

A. Provide premium efficiency motors.

B. Variable Speed Drives:

1. All motors operated by a variable speed drive shall be rated for inverter duty.
2. Motor insulation shall have 1200-Volt peak capacity.
3. Provide shaft grounding (Aegis SGR or equal) on motors to be used with variable speed drives.

2.3 STARTERS

A. Manufacturers:

1. Allen Bradley
2. Cerus
3. Cutler-Hammer
4. General Electric
5. Square D

B. General:

1. Starters shall be standard NEMA sizes and UL listed.

C. Type: Across the line except where noted.

D. Enclosure: NEMA Type as required for location.

E. Overload Protection:

1. Type: Trip-free thermal overload relay.
2. Location: Each ungrounded conductor.
3. Reset: Manual.
4. Ambient Temperature Compensation: Provide where required.
5. Overload protection to be sized for nameplate running amps.

F. Auxiliary Contacts:

1. Provisions to add three without removing starter from enclosure.
2. Number: Provide up to three per starter as required for control sequence, and one (1) auxiliary contact.
3. Switchable type, easily changed from N.O. to N.C. without removing from its mounting.

G. Switches in Cover:

1. Manually Controlled: Three wire start-stop.
2. Automatically Controlled: Hand-off-automatic.
3. Start and stop indicating lights.
4. Equipment used for life safety (smoke exhaust, etc.): Hand-Automatic.
5. Equipment not designed to run continuously: Off-Automatic.

H. Control Transformer:

1. Provide when line voltage exceeds 208-Volts.
2. Secondary wiring shall have one leg fused and the other grounded.
3. Secondary voltage not to exceed 120-Volts.

I. Provide starters for all motors as follows:

1. Single phase motors less than ½ hp.

a. With internal overload protection: None.
b. Without internal overload protection:

1) Manually Controlled: Manual starter.
2) Automatically Controlled: Magnetic starter.

2. Single phase motors ½ hp and larger:

a. Manually Controlled: Manual starter.
b. Automatically Controlled: Magnetic starter.

3. Three Phase Motors: Magnetic starter.

J. Soft Start Starters:

1. Provide Y-Delta or solid state reduced-voltage starters for all motors 5hp and larger.
2. Starter shall limit starting voltage to 200% of full load voltage.

K. Multi-Speed Starters:

1. Starters shall be suitable for the type multi-speed motor selected.
2. Provide time delay for automatic transfer from high to low speed.

L. Housing coils to be 120V.

M. Motor Protection: (above 20 hp)

1. Provide Single-phase protection.
2. Provide undervoltage protection.

PART 3 - EXECUTION

3.1 MOTORS

A. Install motors on motor-mounting systems so coupling or belt drive is properly aligned. Provide proper belt tension. Dowel direct coupled motors.

3.2 STARTERS

A. Deliver to installer of electrical work.

B. All safety devices shall be wired so that they will stop the motor with a hand-off-automatic switch in the hand as well as the automatic position.

END OF SECTION

This page is intentionally left blank.

SECTION 23 05 21 - PIPE AND PIPE FITTINGS

PART 1 - GENERAL

1.1 QUALITY ASSURANCE

A. Welder Qualifications: Welders, both on-site and off-site, shall be certified for the type of work being performed by one of the following:

1. National Certified Pipe Welding Bureau.
2. Intermountain Testing Company

B. Welder Certificates:

1. Submit one copy of certificate to Architect/Engineer.
2. Maintain one copy on project site.

C. LEED:

1. In addition to meeting the general requirements for VOC emissions, detailed in the LEED Reference Guide, on-site wet-applied products must not contain excessive levels of VOCs, for the health of the installers and other trades workers who are exposed to these products. To demonstrate compliance, a product or layer must meet the following requirements, as applicable. Disclosure of VOC content must be made by the manufacturer. Any testing must follow the test method specified in the applicable regulation.

    a. All paints and coatings wet-applied on site must meet the applicable VOC limits of the California Air Resources Board (CARB) 2007, Suggested Control Measure (SCM) for Architectural Coatings, or the South Coast Air Quality Management District (SCAQMD) Rule 1113, effective June 3, 2011.
    b. All adhesives and sealants wet-applied on site must meet the applicable chemical content requirements of SCAQMD Rule 1168, July 1, 2005, Adhesive and Sealant Applications, as analyzed by the methods specified in Rule 1168. The provisions of SCAQMD Rule 1168 do not apply to adhesives and sealants subject to state or federal consumer product VOC regulations.

PART 2 - PRODUCTS

2.1 PIPE AND FITTINGS

A. Refer to the following sections:

1. 21 13 00 - Fire Protection
2. 23 21 13 - Hydronic Piping
3. 23 23 00 - Refrigerant Piping
4. Other Divisions 21 through 23 sections after specific system requirements.

2.2 GROOVED PIPE COUPLING SYSTEMS

A. Manufacturers of Coupling System:

1. Basis of Design: Victaulic
2. Other Acceptable Manufacturers: Grinnell and Gruvlok. Alternate is to provide a system of standard weight black steel pipe with black steel standard weight butt weld or 125 lb. cast iron flanged fittings.
3. All couplings, gaskets and joining method adapters shall be provided by one manufacturer.
4. Training: A factory trained representative shall provide on-site training for contractor's field personnel in the use of grooving tools, application of groove, and product installation.

B. Dimensional Standards:

1. All grooved pipe fittings, couplings, and specialties shall conform to standard dimensional standards ANSI/ANWA C-606 or MIL-P-11087C.

C. Acceptable Products:

1. Only the following grooved pipe products may be used:

a. Gaskets: (ASTM D2000) EHP, for water service, with or without propylene glycol -30ºF to 250ºF, primary seal by compression of coupling housing, either pressure or vacuum shall assist in sealing force.
b. Couplings - Steel Pipe: Ductile iron (ASTM A-536) or malleable iron (ASTM A-47), with enamel paint coating.

1) Rigid Couplings: Style 107, 07, W07 zero flex.
2) Flexible Couplings: Style 177, 77, W77.

c. Flange Adapters: Same materials as couplings. Provide for rigid connection to grooved pipe. Provide flange washers and/or flange gaskets as required for mating to non-standard flanges, such as butterfly valves with elastomeric face, or serrated face flanges.

1) ANSI Class 125 or 150: Style 741.
2) ANSI Class 300: Style 743.
3) Alternate to flange adapter: Flange by groove nipple #41 (Class 125), #45 (Class 150), #16 (Class 300).

d. Branch Outlet Couplings: Design similar to coupling with integral side outlet.
e. Fittings for steel pipe: Standard pattern fittings, ductile iron (ASTM A-536), malleable iron (ASTM A-47) or segmentally welded Schedule 40 steel (ASTM A-53) with enamel paint coating. All changes in direction greater than 22º shall be with R=1.5D radius elbow. All branches and changes in direction in drainage piping shall be made with sanitary type lateral branches and R=1.5D elbows.
f. Accessories: Other piping accessories such as strainers, suction diffusers and flow indicators may be provided with grooved ends, all such accessories shall comply with the applicable specification section.

2. All other pipe products shall conform to the requirements of other Divisions 21 through 23 sections. Acceptance of grooved pipe systems does not imply acceptance of the coupling manufactures valves, branch outlets, strainers, or other specialties.

PART 3 - EXECUTION

3.1 PIPE INSTALLATION

A. General:

1. Install pipe, tube and fittings in accordance with recognized industry practices which will achieve permanently-leakproof piping systems, capable of performing each indicated service without piping failure.
2. Install each run with a minimum of joints and couplings, but with adequate and accessible unions for disassembly, maintenance or replacement of valves and equipment.
3. Reduce sizes by use of reducing fittings.
4. Install piping without springing or forcing.
5. Provide sufficient swing joints, anchors, expansion loops and devices necessary to permit free expansion and contraction without causing undue stresses.
6. Support piping independently at equipment so its weight will not be supported by the equipment.
7. Support piping to maintain a consistent slope as indicated on the drawings without sagging or pocketing of any kind. Where not otherwise indicated, all horizontal piping shall slope a minimum of 1/16 inch per foot to drain at system low points.
8. Provide manual air vents at high points of all pumped piping systems. Provide drains at all low points.
9. Install horizontal piping parallel to building construction, make any changes in direction with fittings.

B. Location:

1. Locate piping runs, except as otherwise indicated, both vertically and horizontally to allow for complete drainage of piping system (pitched to drain).

    a. Avoid diagonal runs wherever possible.
    b. Orient horizontal runs parallel with walls and column lines.

2. Hold piping close to walls, overhead construction, columns and other structural and permanent-enclosure elements of the building.

    a. Limit clearance to 0.5” where furring is shown for enclosure or concealment of piping, but allow for insulation thickness, if any.
    b. Where possible, locate insulated piping for 1.0” clearance outside insulation.

3. Wherever possible in finished and occupied spaces, conceal piping from view by locating in column enclosures, in hollow wall construction or above suspended ceilings.

    a. Do not encase horizontal runs in solid partitions, except as otherwise indicated.

C. Electrical Equipment Spaces: Do not run piping through transformer vaults and other electrical or electronic equipment spaces and enclosures.

1. Exception: where shown on drawings or where accepted by the Engineer, provide drip pan under piping, and conform to NEC.
2. In no case shall piping run directly above transformers, electrical panels or switchgear.

D. Dielectric Unions: Install dielectric unions to prevent galvanic action between ferrous and non-ferrous piping.

1. Install in an accessible location or provide access doors.

3.2 WELDING

A. Welding:

1. Conform to Code for Pressure Piping ANSI B31.
2. Machine cut and bevel piping ends for v-type joints.
3. Use recommended bevels and spacing between ends of pipe to assure full penetration complete to inside diameter of pipe.

B. Welded Joints:

1. Will be observed visually by the Architect/Engineer.
2. Any weld judged defective from a visual observation, shall be ordered tested at the expense of the Contractor or chipped out for full depth and re-welded.

C. Welding Fittings:

1. Unless otherwise noted, make all changes in direction and branch take offs with manufactured fittings.

    a. Use long radius (R=1.50) fittings wherever possible.

2. Shop Fabricated Fittings:

    a. Branches more than two pipe sizes smaller than main line may be made with “weld-o-let” type pre-manufactured saddle fittings.
    b. Where specifically allowed by the Engineer, angles of less than 22½º and branch piping from headers may be made by shop fabricated or manufactured metered fittings.
    c. Submit shop drawings.
    d. Thoroughly clean fittings to remove slag.
    e. Fittings shall be available for observation by the engineer prior to installation.

3. In no case will field made miters or weld-o-let fittings be allowed. Exception: Temperature control wells and water treatment taps may be made with weld-o-let fittings in pipe 3” or larger in diameter.

3.3 COPPER TUBING JOINTS AND FITTINGS

A. Unless otherwise noted, make all couplings, changes in direction, branch outlets, and transitions to other materials or joining methods with standard manufactured fittings.

B. Do not expand or swage piping in lieu of proper solder fittings.

C. Do not extrude or “pull” branch outlets with “tee-drill” type equipment.

D. Do not use self-tapping type branch outlets.

1. See “hot taps” below.

3.4 THREADED JOINTS AND FITTINGS

A. All threaded joints shall be made in accordance with American National Standard B2.1.

1. Do not overthread pipe.
2. Apply pipe joint compound on male threads only.
3. Do not use right and left hand threaded joints to make a “union”.

B. Do not thread steel pipe schedule 10 or lighter.

1. UL listed light wall pipe may be threaded in accordance with its listing.

3.5 MECHANICAL COUPLING SYSTEMS

A. All changes in direction shall be made with radius type elbows.

1. Use long radius (R=1.5D) fittings wherever possible.
2. Angles less than 22½º may be made with pre-manufactured metered fittings.
3. Use of the angular deflection capabilities of grooved pipe couplings for intentional changes of direction shall not be allowed.

B. All branch outlets shall be made with pre-manufactured 3-way fittings.

1. Shop fabricated Weld-o-let style welded saddle fittings may be used for branches more than two pipe sizes smaller than the main.
2. Mechanical saddle tap fittings shall not be allowed.

C. Pipe shall be adequately laterally supported to prevent “pipe squirm”. Provide a minimum of one hanger per pipe section. No pipe section shall be left unsupported between any two couplings.

1. Rigid type couplings may be considered equivalent to welded or soldered pipe for the above requirements.

D. Risers more than 20’ high shall be made with rigid type couplings.

E. Grooved pipe systems shall not be considered to be electrically conductive.

1. Provide wire jumpers across all couplings where the piping system is required to be electrically conductive.
2. Cold water piping using grooved pipe systems shall not be used for building ground.

a. Provide an engraved plastic sign at the building water entrance stating, “Mechanical Coupling System”. Not Electrically Conductive”.

F. Flexible couplings may be used for thermal expansion/contraction compensation.

1. Use a minimum of 1 flexible coupling for every 100 feet for chilled water piping.
2. Use a minimum of 1 flexible coupling for every 50 feet for hydronic hot water piping.
3. The above is for cut grooved pipe. Double the amount of the connectors with roll grooved pipe and fittings.

3.6 CLEANING, FLUSHING, INSPECTING

A. Clean exterior surfaces of installed piping systems of superfluous materials, and prepare for application of specified coatings, if any.

B. Flush out water and piping systems with clean water before proceeding with required tests.

C. See specific pipe service section for further requirements.

3.7 PIPING TESTS

A. Provide temporary equipment for testing, including pump, thermometer and gauges.

B. Test piping system before insulation is installed wherever feasible, and remove control devices before testing.

C. Test each natural section of each piping system independently, but do not use piping system valves to isolate sections where test pressure exceeds valve pressure rating.

D. Fill each section of water, drain or vent piping with water and pressurize for two hours at 150% of operating pressure, but not less than 25 psig for pressure piping, and ten feet of head for drain and vent piping.

E. Test fails if leakage is observed, or if temperature compensated pressure drop exceeds 1% of test pressure.

F. Disassemble and re-install sections which fail the test by using new materials to the extent required to overcome leakage.

1. Do not use chemicals, stop-leak compounds, mastics, or other temporary repair methods.

G. After testing and repair work have been completed, drain test water from piping systems.

3.8 PAINTING

A. Exposed piping shall be painted. Pipe shall be cleaned by this contractor and ready for priming and painting. Painting to be by architectural division.

END OF SECTION

SECTION 23 05 22 - PIPING ACCESSORIES

PART 1 - GENERAL

1.1 SUBMITTALS

A. Manufacturer's Data - Piping Accessories: Submit manufacturer's data on the following piping accessories:

1. Sealing compound for sleeves.
2. Expansion compensators.
3. Flexible pipe connections.
4. Guides.

B. LEED:

1. In addition to meeting the general requirements for VOC emissions, detailed in the LEED Reference Guide, on-site wet-applied products must not contain excessive levels of VOCs, for the health of the installers and other trades workers who are exposed to these products. To demonstrate compliance, a product or layer must meet the following requirements, as applicable. Disclosure of VOC content must be made by the manufacturer. Any testing must follow the test method specified in the applicable regulation.

    a. All paints and coatings wet-applied on site must meet the applicable VOC limits of the California Air Resources Board (CARB) 2007, Suggested Control Measure (SCM) for Architectural Coatings, or the South Coast Air Quality Management District (SCAQMD) Rule 1113, effective June 3, 2011.
    b. All adhesives and sealants wet-applied on site must meet the applicable chemical content requirements of SCAQMD Rule 1168, July 1, 2005, Adhesive and Sealant Applications, as analyzed by the methods specified in Rule 1168. The provisions of SCAQMD Rule 1168 do not apply to adhesives and sealants subject to state or federal consumer product VOC regulations.

PART 2 - PRODUCTS

2.1 MANUFACTURED PRODUCTS

A. Escutcheon Plates:

1. Type: Split ring
2. Construction: Brass
3. Finish:

    a. At Painted Surfaces: Prime coat
    b. At Other Surfaces: Nickel or Chrome plate

4. For Floor Sleeves: Where sleeves extend above floor surface, provide depth to cover sleeve.

B. Flexible Pipe Connectors, Rubber Type:

1. Manufacturers - Design Basis: Mason
2. Other Acceptable Manufacturers:

   a. Flexicraft
   b. Keflex
   c. Metraflex

3. Material: Two sphere EPDM construction with reinforcing ring.
4. Model: MFTNC, Twin Sphere 225 psi.

C. Flexible Pipe Connectors, Braided Hose:

1. Manufacturers - Design Basis: Mason
2. Other Acceptable Manufacturers:

   a. Flexicraft
   b. Keflex
   c. Metraflex

3. Material: Stainless steel braid with carbon steel connectors, threaded or flanged.

2.2 FABRICATED ACCESSORIES

A. Steel-Pipe Sleeves: Fabricate from Schedule 40 steel pipe. Remove burrs.

B. Iron-Pipe Sleeves: Fabricate from service weight cast-iron pipe. Remove burrs.

C. Sheet-Metal Pipe Sleeves: Fabricate from galvanized sheet-metal, closed with lock-seam joints.

1. For following pipe sizes, provide gauge indicated:

   a. Three-Inch Pipe and Smaller: 20 gauge
   b. Four-Inch to Six-Inch Pipe: 16 gauge
   c. Over Six-Inch Pipe: 14 gauge

PART 3 - EXECUTION

3.1 INSTALLATION

A. Pipe Sleeves:

1. Install pipe sleeves where piping passes through walls, floors, ceilings, roofs and structural members, except soil pipe penetrations through concrete slab on grade.
2. Where possible pour sleeve in place or grout.
3. Provide sleeves of adequate size, accurately centered on pipe runs, so that piping and insulation (if any) will have free movement in the sleeve in non-fire rated penetrations.
4. In fire rated penetrations, size sleeves such that the resulting annular space is in accordance with the application requirements of the fire stopping system. Refer to Section 23 05 03. All above grade floor penetrations shall be considered to be fire-rated.

5. Install length of sleeve equal to thickness of construction penetrated, except extend floor sleeves 0.25” above floor finish and, where floor surface drains to a floor drain, extend floor sleeve 0.75” above floor finish.
6. Provide temporary support of sleeves during placement of concrete and other work around sleeves.
7. Provide temporary closure to prevent concrete and other materials from entering pipe sleeves.
8. Except as otherwise indicated, install steel pipe sleeves.
9. At interior partitions and ceiling, install sheet metal sleeves.
10. At exterior penetrations below grade, install iron pipe sleeves.
11. Seal exterior sleeve penetrations at grade weather tight.

B. Caulking:

1. Where water seal or sound seal, but not fire seal, is needed, (foundation walls, slab on grade): fiberglass backing and heavy bead of silicone caulking compound.
2. Where sleeve pierces a fire separation: Fire stop material in accordance with manufacturer’s directions and UL listing. Refer to Section 23 05 03.

C. Install escutcheon plates at pipe sleeves where piping is exposed to view in occupied spaces of the building, on the exterior, and elsewhere as indicated.

D. Compensators: Install where shown or where required because piping arrangement does not provide sufficient flexibility.

1. Protect compensators from over-travel and over-stress during remaining installation and testing.

E. Flexible Connectors: Install at right angles to displacement.

1. Install one end immediately adjacent to isolated equipment and anchor other end.

F. Guides: Install where shown and where required in accordance with expansion compensators published requirements.

1. As a minimum, install one guide within four pipe diameters of compensator, and one guide 14 pipe diameters from first guide.

END OF SECTION

This page is intentionally left blank.

SECTION 23 05 23 - VALVES

PART 1 - GENERAL

1.1 SUBMITTALS

A. Manufacturer's Data: Submit manufacturer's product data including:

1. Dimensions
2. Sizes
3. End Connections
4. Weights
5. Installation instructions
6. Instructions on repacking and repairing valves.
7. Range of flow and full open (permanent) pressure loss for balancing valves and plug valves.
8. Differential pressure tables for flow measurement at venturi type balancing valves.

B. Valve Tag List: Refer to Section 23 05 53 of the Specifications.

PART 2 - PRODUCTS

2.1 VALVE TYPES AND SIZES

A. General:

1. Where type or body material is not indicated, provide valve with pressure class selected from MSS or ANSI standards, based on the maximum pressure and temperature in the piping system.
2. All valves in contact with domestic water shall meet the requirements of NSF/ANSI Standard 61.
3. Except for balancing or otherwise indicated, provide valve of same size as connecting pipe size.
4. Ball valves or butterfly valves may be used in lieu of gate valves when pressure and temperature ratings are adequate.
5. Where pipe sizes overlap, contractor has the option of threaded or flanged valves.
6. Where grooved pipe mechanical coupling systems are accepted, provide flange adapters to mate with valves as specified below. Valves by the mechanical coupling system manufacturer shall not be used unless they meet all of the specified requirements for a given valve.
7. All valves shall be domestically manufactured unless approved for use by Engineer.
8. Valves used for domestic water service shall be bronze or stainless steel. Iron and brass body valves are not acceptable.
9. All components in hydronic systems shall be compatible with propylene glycol and water solution.a.

B. Unless noted otherwise, the following table indicates valve types to be used for functions listed. Manufacturer listed is basis of design. Refer to specification section indicated for additional requirements.

Service	Chilled Water	Heating Hot Water
Shutoff/ Isolation	2-1/2" and larger: • Type BTV Butterfly Valve 2" and smaller: • Type BV Ball	2-1/2" and larger: • Type BTV Butterfly Valve 2" and smaller: • Type BV Ball
Check	2" and larger: • Type SWCV Silent/Wafer Check 1-1/2" and smaller: • Type SCV Swing Check	2" and larger: • Type SWCV Silent/Wafer Check 1-1/2" and smaller: • Type SCV Swing Check
Balance	2-1/2" and larger: • Type BLV Manual 2" and smaller: • Type BLV Manual	2-1/2" and larger: • Type BLV Manual 2" and smaller: • Type BLV Manual
Base Mounted Pump Discharge	All sizes: • Type TCS Combination Throttling/ Check Valve	All sizes: • Type TCS Combination Throttling/ Check Valve
Inline Pump Discharge	All sizes: • Type SWCV Silent/Wafer Check	All sizes: • Type SWCV Silent/Wafer Check
Drain Valve	All sizes: • Type BV Ball	All sizes: • Type BV Ball •
Bypass	RE: Shutoff/Isolation	RE: Shutoff/Isolation

1. Refer to section 22 10 00 Plumbing Piping for additional Domestic Water valve specifications and requirements.
2. Refer to Division 22 specifications for additional system valves and specialties not indicated in table above.

2.2 SWING CHECK VALVES – TYPE SCV

A. Manufacturers:

1. Design Basis: Milwaukee
2. Other Acceptable Manufacturers:

   a. Crane
   b. Gruvlock
   c. Nibco
   d. Powell
   e. Stockham
   f. Victaulic (for Grooved Pipe Systems)

B. Size 2" and Smaller: Bronze, 200 psi SWP, 400 psi WOG, 5º straight through pattern, bronze disk, stainless-steel seat, MSS-SP 80, Type 3.

1. Model: 518

C. Valves used for domestic water service shall be ANSI/NSF-61 certified.

2.3 SILENT/WAFER CHECK VALVES – TYPE SWCV

A. Manufacturers:

1. Design Basis: Metra Flex
2. Other Acceptable Manufacturers:

a. Cla-Val
b. GA Industries
c. Gruvlok
d. Nibco
e. Stockham
f. Tyco
g. Victaulic (for Grooved Pipe Systems)

B. Size 2” and Smaller: Bronze body, 200 psi @ 250 °F, threaded ends, resilient seats, center guided disk.

1. Model: 5700

C. Pipe size 2 1/2 “ and Larger: Iron body, bronze or stainless-steel trim, class 125, 316 stainless-steel spring, dual plate or tilting disk type, resilient seat, minimum C_V: 4”-280, 8”-1200, 12”-4000.

1. Model: 810

D. Valves used for domestic water service shall be ANSI/NSF-61 certified.

2.4 BUTTERFLY VALVES – TYPE BTV

A. Manufacturers:

1. Design Basis: Keystone
2. Other Acceptable Manufacturers:

a. Bray
b. Center Line
c. Crane
d. Gruvlok
e. Hammond Watts
f. Keystone
g. Milwaukee
h. Nibco
i. Stockham
j. Victaulic (for Grooved Pipe Systems)

B. Water Service (less than 250ºF): 200 psi WOG, cast or ductile iron fully lugged body, integral extended neck to clear insulation, integral top plate for actuator mounting, stainless-steel stem, upper and lower lubricated bushings, field replaceable hard back seat with integral stem and flange seals, machined disk seating areas, rated for minimum 150 psi dead end service with no downstream flange. Liner to be compatible with operating fluid. Conform to MSS-SP67.

1. Disk Material - 8” and Under and all sizes for condenser or domestic water: Aluminum bronze.

2. Disk Material, 10” and Larger: Nickel plated ductile iron.
3. Model: Figure 2-22.

C. Accessories:

1. 10 position locking lever handle for valves 6” and smaller.
2. Infinite position memory stop lever handle for all valves 6” and smaller used for balancing.
3. Hand wheel gear operator for valves 8” and larger.
4. Chain wheel operator where required.

2.5 BALL VALVES – TYPE BV

A. Manufacturers:

1. Design Basis: Nibco
2. Other Acceptable Manufacturers:

a. Apollo
b. Bray
c. Dyna Quip
d. Gruvlok
e. Hammond
f. Milwaukee
g. Stockham
h. Victaulic (for Grooved Pipe Systems)
i. Watts

B. Valve bodies must be cast bronze. Forged brass is not acceptable.

C. Bronze, 150, SWP, 600 WOG (min), chrome plated solid, tunneled bronze ball (stainless for steam service), two-piece design, blow-out proof stem, adjustable packing gland nut (allowing handle to be removed without leaking) TFE seats, MSS-SP-110.

1. Model: T-585-70 - full.port.

D. Valves used for domestic water service shall be ANSI/NSF-61 certified.

E. Options: Provide the following where required:

1. Extended stems for insulated valves.
2. Memory stop device for balancing applications.
3. Tee handle for tighter areas.
4. Hose end and cap for drain.
5. Mounting pads for actuator.
6. Bleed port or “stop and drain” for compressed air.

2.6 COMBINATION THROTTLING/CHECK VALVES – TYPE TCS

A. Manufacturers:

1. Basis of Design: Bell & Gossett Triple Duty Valve.

2. Other Acceptable Manufacturers:

    a. Armstrong
    b. Taco
    c. Victaulic (for Grooved Pipe Systems)
    d. Watts

B. Features:

1. 175 psi, 250ºF water working pressure.
2. Globe style valve with stainless-steel spring-loaded brass disk guided and limited by a brass or stainless-steel stem.
3. Resilient seat.
4. Able to be re-packed under pressure.

2.7 DRAIN VALVES – TYPE DV

A. Ball valve with hose end adapter and cap.

2.8 PLUG VALVES – TYPE PV

A. Manufacturers:

1. Design Basis: Keystone
2. Other Acceptable Manufacturers:

    a. Dezurik

B. Model: “Ballcentric”; cast-iron, full port body; EPDM coated plug; welded nickel seat; stainless-steel bearings; integral memory stop device; hand wheel operator for valves 6” and larger.

2.9 BALANCING VALVES – TYPE BLV

A. Manufacturers:

1. Design Basis: IMI Hydronic Engineering (Flow Design).
2. Other Acceptable Manufacturers:

    a. Armstrong
    b. Griswold
    c. Hays
    d. Nexus
    e. Nibco
    f. NuTech
    g. Tour and Andersson

B. Manual Balancing Valves (1/2" through 2"):

1. 400psi at 250°F, venturi type, with integral ball valve, brass body, EPDM O-ring seals, two pressure/temperature ports, and manual air vent. Memory stop with graduated markings. PTFE ball valve seats with blowout proof stem. Soldered or threaded connections.
2. Each valve shall provide four (4) functions:

    a. Precise flow measurement
    b. Precision flow balancing
    c. Positive shut-off with no drip seat, eliminating the need of an additional isolation valve.
    d. Manual air venting.

C. Balancing Valves (2-1/2" - 16"):

1. 240 psi at 250°F, venturi type, with integral butterfly valve, steel body, and two pressure/temperature ports. Flanged connections.
2. Butterfly valve: 200 psi WOG, cast or ductile iron fully lugged body, lever handle, infinite position adjustment, memory stop, integral extended neck to clear insulation, stainless-steel stem, upper and lower lubricated bushings, field replaceable hard back seat with integral stem and flange seals, machined disk seating areas, rated for minimum 150 psi dead end service with no downstream flange. Liner to be compatible with operating fluid. Conform to MSS-SP67.
3. Butterfly Valve Disk: Aluminum Bronze.

PART 3 - EXECUTION

3.1 GENERAL

A. Comply with the following requirements:

1. Install valves except butterfly with stems pointing up, and as close to vertical as possible. Butterfly valves to be offset at least 10° from vertical.
2. Install valves at each piece of equipment, fixture or appliance so that the supply and return services can be shut off to remove the item without draining the remainder of the piping system.
3. Install valves where required for proper operation of piping and equipment, including valves in branch lines where necessary to isolate sections of piping.

    a. Locate valves so as to be accessible.

4. Combination balancing and shut-off valves may be used instead of a separate balancing valve and shut-off valve if the valve has a memory stop and the manufacturer lists its use as a leak-proof service valve.
5. Provide drain valves at main shut-off valves, low points of piping and apparatus.
6. Provide separate support where necessary.
7. Do not allow meter connections of balancing valves to point downward.
8. Install valves so bypass valves are accessible.

B. All valves of a given type shall be of one manufacturer.

C. Provide extended stems on insulated system to prevent interference of operator with insulation.

D. Provide chain wheel operators for valves more than 8’ – 0” AFF in mechanical rooms and wherever shown on drawings.

3.2 CHECK VALVE INSTALLATION

A. Swing and Check Valves:

1. Install only in horizontal lines unless absolutely impractical. If installed vertically, flow shall be upwards.
2. Do not install in pump discharge piping.

B. Silent Check Valves:

1. Silent check valves may be installed in vertical pipes with flow down upon Engineer’s review for each instance.

3.3 VALVES USED FOR THROTTLING/BALANCING

A. Balancing valves shall not be used for flow indication in pipes 2½” and larger, or in pump discharge piping.

B. Flow indication in piping 2½” and larger and in pump discharge piping, shall be by a venturi with a plug, butterfly, or globe valve for throttling.

C. Throttling/Balancing Valves shall be selected so that the maximum design flow causes between 1’ and 10’ W.G. pressure drop or meter reading with the valve wide open.

D. Install balancing valves used for flow indication with a minimum of five times the pipe diameter downstream and two times the pipe diameter upstream of a fitting or valve.

E. Globe, ball, butterfly, or plug valves may be used for throttling/balancing. Provide an infinitely variable, lockable memory stop device to allow the valve to be returned to the “balanced” position after closing, and to prevent movement of the disk or plug during operation. When ball valves are used for throttling, provide an additional valve for equipment isolation.

F. Balancing valve sized to flow.

G. Insulation: Provide pre-molded insulation conforming to the valve body. Material shall have a flame spread of 25 and a smoke development of 50.

3.4 COMBINATION THROTTLING/CHECK VALVES

A. Combination throttling/check valves may be used in lieu of separate throttling and check valves on pump discharge piping. However, they may not be used for flow measurement.

END OF SECTION

This page is intentionally left blank.

SECTION 23 05 29 - PIPE SUPPORTS AND ANCHORS

PART 1 - GENERAL

1.1 STANDARDS

A. ASME B31.1 (American Society of Mechanical Engineers) – Power Piping.

B. Comply with MSS Standard Practice SP-69, published by Manufacturer's Standardization Society of the Valve and Fitting Industry for type and size.

C. NFPA 13 2010 (National Fire Protection Association) – Installation of Sprinkler Systems.

D. UPC 2012 (Uniform Plumbing Code) – Defines support spacing of hangers

1.2 SUBMITTALS

A. Submit manufacturer's product data on the following:

1. Hangers other than clevis type.
2. Anchors.

B. Submit structural calculations on trapeze type supports.

C. Submit product data and calculations to project structural engineer for review. Submittals shall document compliance with current Building Codes and maximum point loads listed in Structural plans.

PART 2 - PRODUCTS

2.1 PIPE HANGERS

A. General:

1. Use adjustable pipe hangers on suspended pipe. Trapeze hangers may be used at the Contractor's option. Contractor shall be responsible for sizing supports.
2. Chain, wire or perforated strap hangers will not be permitted.
3. Isolate hangers in contact with dissimilar materials with dielectric hanger liners. Tape is not acceptable.
4. Provide supports between piping and building structure where necessary to prevent swaying.

B. Hanger and Rod Material:

1. Exposed in public areas: Zinc electroplated steel.
2. Concealed or in service areas: Black threaded steel.
3. Outside, exposed to weather: Hot dipped galvanized.
4. Buried below structural slab: Stainless Steel

C. Cast-In- Place Inserts:

1. Cast-in-place inserts system shall be used.
2. Inserts to be UL and FM listed for their application.
3. Cast-In-Place Anchors shall be designed per ACI 318 Appendix D Strength Design methods as required by the IBC 2012 and ASCE 7-10. Where exempt from ACI 318 Appendix D, anchors shall be designed using Allowable Stress Service loads if allowed by the Building Code.
4. Cast In Place inserts shall be tested in accordance with current ICC-ES acceptance criteria A.C. 446 or ACI 355.2 where required.
5. Cast In Place inserts in concrete shall have a current ICC-ES or IAPMO-UES listed Research Report. Anchors shall be installed in strict accordance with approved ICC-ES or IAPMO-UES Research Report for the specific anchor used.
6. Threaded Inserts shall conform to ASTM A307.
7. Size inserts to match size of threaded hanger rods.
8. Manufacturers:

    a. DEWALT Bang-It+, Wood-Knocker II+, or DDI+
    b. Hilti KCM WF or KCM MD
    c. Simpson Blue Banger Hanger

D. Channel Type Inserts:

1. Standard channel support with anchor tabs on 4” centers, and nail holes for attaching to forms.
2. Styrofoam inserts to prevent wet concrete seepage.
3. Minimum 2000 pounds/foot capacity.

E. Expansion, Screw, or Drop-In Anchors:

1. For use only where modifications to piping layouts to change from pre-installed insert locations and only under approval from the Engineer.
2. Inserts shall be wedge-type or screw type and shall be designed per ACI 318 Appendix D Strength Design methods as required by the IBC 2012 and ASCE 7-10. Anchors shall be tested in accordance with current ICC-ES acceptance criteria A.C. 193 or ACI 355.2. Anchors in concrete shall have a current ICC-ES or IAPMO-UES listed Research Report. Anchors shall be installed in strict accordance with the approved ICC-ES or IAPMO-UES Research Report for the specific anchor used.
3. Manufacturers:

    a. DEWALT Power-Stud+ SD2 or Screw-Bolt+
    b. Hilti Kwik-Bolt TZ
    c. Hilti KWIK HUS EZ
    d. Hilti KWIK HUS EZ I
    e. Hilti HDI P TZ
    f. Simpson Strong Bolt 2 or Titen HD Rod Hanger

4. Power driven fasteners are not acceptable.
5. All Drop-in type anchors must be approved for cracked concrete.
6. Anchors shall be installed with all required nuts, washers.
7. Install anchors per Manufacturer’s recommendations with proper torque values where required.
8. Interior: Carbon steel anchors complying with ASTM A307.
9. Exterior or Wet Environment: Series 300 stainless-steel anchors, nuts and washers.

10. Anchors shall comply with loading requirements as designated by the Engineer of Record or per the Building Code.

F. Steel Structure Attachments:

1. Contractor may select welded or mechanically attached. All mechanically attached supports shall have jam nuts or other means to prevent loosening. Maximum loading requirements are as follows:

Rod Size	Maximum Working Load
3/8	600 pounds
1/2	1100 pounds
5/8	1800 pounds
3/4	2700 pounds
7/8	3700 pounds

G. Single Hangers:

1. Piping 2” and smaller: MSS type 1, Clevis hanger or type 7 adjustable swivel ring hanger. Minimum 180 pounds design load.
2. Piping 2½” and larger: MSS type 1 Clevis hanger.
3. Bare copper pipe: Above hangers, plastic or Neoprene coating, sized for copper pipe O.D. and copper coated for identification.
4. Insulated pipe: Hangers to be sized for O.D. of insulation. Hangers shall not penetrate any insulation.

H. Trapeze hangers and wall supports:

1. Channel strut or structural steel shapes. Contractor shall follow channel strut manufacturers guidelines for loading or provide structural steel supports designed by a professional Engineer, licensed in the same state as where the project is located.
2. All piping shall be attached to the support by means of a channel strut clamp, U-bolt, or pipe rollers which will maintain lateral position of the pipe but allow longitudinal movement. Provide dielectric isolation between all dissimilar metals.
3. All insulation shall be continuous at supports. Do not notch or penetrate insulation.

I. Vertical Supports: Steel riser clamp at each floor penetration or every 14 foot supported from wall bracket. Do not anchor riser clamps.

J. Hangers:

1. General: Adjustable wrought steel clevis with locking nut attachment.
2. Multiple or Trapeze: Steel channels with welded spacers and hanger rods.
3. Hanger Sizes and Spacing:

    a. For gas, domestic water and drain piping, conform to Chapter 2, Part 5, Section 121 of ASME B31.1 (Standard for Pressure and Power Piping) and applicable plumbing code.

b. For steam and hydronic piping, conform to the following table:

PIPE TYPE	PIPE SIZE	MAXIMUM SPACING	MINIMUM HANGER ROD SIZE
Steel Pipe	1/2”	6’-0”	3/8”
	3/4” thru 1¼”	8’-0”	3/8”
	1½” and 2”	10’-0”	3/8”
	2½” thru 3½”	12’-0”	1/2”
	4” and 5”	15’-0”	5/8”
	6”	17’-0”	3/4”
*	8” thru 12”	12’-0”	7/8”
*	14” thru 18”	10’-0”	1¼”
*	20” thru 30”	8’-0”	1½”
Copper Pipe	1/2” thru 1”	6’-0”	3/8”
	1¼” thru 2”	10’-0”	3/8”
	2½” thru 3”	10’-0”	1/2”
Cast Iron Soil	2”		3/8”
	3” to 5”		1/2”
	6”		5/8”
*	8” to 12”		3/4”

* Submit routing and support plans to Architect/Engineer for review.

K. Insulated Pipe Supports:

1. Size pipe supports for outside diameter of pipe insulation.

L. Wall Supports:

1. 1/2” through 3”: Unistrut type channel and steel clamp.

   a. Use Hydra-Zorb cushions on copper pipe.

2. 4” and Over: Welded steel bracket and wrought steel clamp.

M. Pipes over five inches and over 120º: Provide cast iron roller supports.

2.2 INSULATION INSERTS

A. All insulated pipes shall be protected at the point of support by insulation inserts. Insert to be same thickness as adjoining pipe insulation. Materials shall be suitable for use in an air plenum.

B. Provide any of the following products:

1. High density, 100 psi, waterproofed calcium silicate, encased in a sheet metal shield. Shield shall extend one inch beyond sheet metal shield. If pipe hanger spacing exceeds ten feet and for all pipe roller applications, utilize double layer shield on bearing surface.
2. Trymer Polyisocyanurate Foam insulation (urethane). Provide compressive strength and temperature range as required for pipe served. Insert shall be provided with factory applied vapor barrier.

   a. Manufacturers: Snapp Itz Mechanical Pipe Shields (BBMI, LLC) or pre-approved equal.

b. Not for use on steam piping or other piping above 225° F.

C. Provide 180º insulation inserts when utilizing clevis hangers. Provide 360º insulation inserts at all trapeze and wall supports.

2.3 PIPE ANCHORS

A. Manufacturers:

1. Anvil
2. Cooper Industries B-Line
3. Mason
4. Metraflex

B. Design Basis – Any of the following:

1. Pipe Riser Anchor Clamp: Metraflex Riser Anchor Clamp
2. Low Load Anchor Clamp: Metraflex Model PA Anchor Clamp
3. Pre-insulated Anchor Clamp: Metraflex Model PAPI
4. Welded Structural W-Section Anchor: Metraflex Model PAI Structural I-beam Anchor

C. Material:

1. Material in contact with pipe shall be steel for steel pipe, bronze for copper tubing. Where clamp anchors are a dissimilar metal to piping, provide FRP pad secured to the pipe with epoxy adhesive to prevent metal to metal contact between clamp and pipe.

D. Anchors may be field fabricated similar to manufactured products specified.

E. Submit pipe stress analysis for review prior to installation of pipe anchors.

2.4 PIPE GUIDES

A. Manufacturers:

1. Adsco
2. Anvil
3. Cooper Industries B-Line
4. Flexicraft
5. Keflex
6. Mason
7. Metraflex
8. PHD

B. Design Basis – Any of the following:

1. Spider Type: Metraflex Style IV Spider Type guide
2. Roller Type: Two sets of rollers on opposite sides of pipe
3. Slide Type: Cooper Industries B-Line B3893 with hold down lugs (not for use with cold piping)
4. Light duty, 1-1/2” and smaller copper: U-bolt or channel strut clamp allowing clearance from O.D. of pipe or insulation
5. Pipe Riser Guides: Metraflex Modular Riser Guide

C. Material: Material in contact with pipe shall be steel for steel pipe, bronze for copper tubing. Where guides are a dissimilar metal to piping, provide FRP pad secured to the pipe with epoxy adhesive to prevent metal to metal contact between guide and pipe.

2.5 EXPANSION COMPENSATORS

A. Expansion Compensators, Two Inch and Smaller, Loop Type:

1. Manufacturers - Design Basis: Metraflex
2. Other Acceptable Manufacturers:

    a. Adsco
    b. Flexicraft
    c. Keflex
    d. Mason

3. Model: Metraloop

B. Expansion Compensators, Bellows Type:

1. Manufacturers – Design Basis: Metraflex
2. Other Acceptable Manufacturers:

    a. Adsco
    b. Flexicraft
    c. Keflex
    d. Mason

3. Model: MNLC, 300 psi max. working pressure

2.6 ROOF-MOUNTED PIPING

A. Manufacturers

1. B-Line Dura-Blok
2. Miro Industries, Inc.
3. PHD Manufacturing
4. PHP Systems/Design
5. Approved Equivalent.

B. Description: Piping on roof shall be supported by an engineered prefabricated portable pipe system specifically designed to be installed on the roof without roof penetrations, flashing or damage to the roofing material. The system shall consist of recycled rubber or plastic bases, hot dipped galvanized or stainless-steel frame with threaded rods and suitable pipe hangers and supports. The system shall be custom designed to fit the piping and conduits to be installed and the actual conditions of service.

PART 3 - EXECUTION

3.1 INSTALLATION OF PIPE SUPPORTS

A. Adequately support piping from the building structure with adjustable hangers to maintain uniform grading where required and to prevent sagging and pocketing.

1. Provide supports between piping and building structure where necessary to prevent swaying.
2. Do not support pipe from other pipe or equipment.
3. Provide thrust restraints at all changes in direction on 8” and larger cast iron piping with no hub or hub and spigot fittings.

B. Install hangers to provide minimum 1/2” clear space between finished covering and adjacent work.

1. Place a hanger within one foot of each horizontal elbow.
2. Space hangers generally as called for in Table in Part 2, Products.

C. Use hangers, which are vertically adjustable 1-½” minimum after piping is erected.

D. Use inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams wherever practicable.

1. Set inserts in position in advance of concrete work.
2. Where concrete slabs form finished ceiling, finish inserts flush with slab surface.
3. Do not penetrate concrete “TT” legs for piping inserts. Do not penetrate the stressed (i.e. lower) chords of any structural member.

E. Expansion anchors or screw anchors: For use only where modifications to piping layouts to change from pre-installed insert locations and only under approval from the Engineer.

1. Installation shall be in strict compliance with ICC-ES or IAPMO-UES Research Report criteria.
2. Expansion anchors require periodic special inspection as required by their ICC-ES or IAPMO-UES Research Report.
3. Special inspector shall make periodic inspections of installation for compliance with manufacturer’s installation instructions.

F. Provisions for Movement: Install hangers and supports:

1. To allow controlled movement of piping systems.
2. To permit proper movement between pipe anchors.
3. To facilitate the action of expansion joints, expansion loops, bends and offsets.
4. To isolate force due to weight or expansion from equipment connections.

G. In general, attach hangers to upper chord of roof trusses and floor joists, using long rods to facilitate pipe movement.

H. Anchors:

1. Use no pipe anchors. Arrange piping such that pipe expansion and contraction is accommodated by controlled movement of the pipe within the pipe supports. Provide sufficient offsets in branch piping to accommodate movement of main piping due to expansion and contraction.

END OF SECTION

SECTION 23 05 30 - ELECTRONIC SPEED CONTROLLERS

PART 1 - GENERAL

1.1 SUBMITTALS

A. Submit manufacturer's product data for each unit. Include:

1. Capacity:

a. Horsepower
b. KVA
c. Amps

2. Wiring Diagrams:

a. Include diagrams for basic unit and for all required accessories.

3. Dimensions.
4. Installation instructions.
5. Description of diagnostic system.
6. Options provided.
7. Time-current curves for VFD circuit.

B. Show compliance with IEEE 519 – provide harmonic analysis for project jobsite including total harmonic-voltage distortion and total harmonic current distortion (TDD). The VFD manufacturer shall provide calculations; specific to this installation, showing total harmonic-voltage distortion is less than 5%. Input filters shall be sized and provided as required by the VFD manufacturer to ensure compliance with IEEE standard 519. All VFDs shall include a minimum of 5% impedance reactors, no exceptions.

PART 2 - PRODUCTS

2.1 GENERAL

A. Manufacturer:

1. Manufacturers:

a. ABB
b. Cutler-Hammer
c. Danfoss
d. Eaton
e. Franklin Controls Systems
f. General Electric
g. Hitachi
h. Honeywell
i. Magnetek
j. Mitsubishi
k. Reliance

l. Robicon
m. Square D
n. Toshiba
o. Trane
p. Yaskawa

B. Single Manufacturer

1. Provide all drives, except those factory mounted, by a single manufacturer.
2. “Factory Mounted” means as part of a packaged unit where the drive is not purchased separately from the driven equipment.

C. Drive shall convert the constant frequency AC line voltage to a variable frequency, variable voltage AC output suitable for control of a standard NEMA design B induction motor over a 10:1 speed range and with full load amp rating between 10% and 110% of the drive full load current capability and without modification to the motor or the drive.

D. Variable frequency drives for motors greater than 5 HP shall have the following features:

1. Drive input: 480-Volts +/- 10%, 3 phase, 60 Hz, 65 KAIC minimum or as shown on electrical drawings.
2. Drive output: 0-460-Volts, 3 phase, 0-80 Hz. For efficient operation of a variable torque load.
3. Drive type: Pulse width modulation type, designed to minimize harmonic generated noise in the motor.
4. Enclosure type: NEMA 1 or NEMA 4 depending upon mounting location. Unit to operate in ambient temperatures of -40F to 155F. Where variable frequency drive is located in an area that is subject to unauthorized access (i.e. parking garage, service corridor, storage room, etc.), provide tamper-proof enclosure by drive manufacturer or provide secondary lockable fan-vented enclosure to prevent unauthorized access. Secondary enclosure shall be approved by variable frequency drive manufacturer.
5. AC line fused disconnect or circuit breaker.
6. Metal oxide varistors on incoming line for transient protection.
7. Control power transformer with fused primary and 24V or 120V fused secondary.
8. Manual, speed adjustment potentiometer of keypad, HAND-OFF-AUTO switch, and 4-20 milliamp signal follower, fully isolated and suitable for grounded or ungrounded input signal. Drive manufacturer shall coordinate exact signal type with temperature control contractor.
9. Instantaneous overcurrent shutdown with indicator light when current exceeds 200%. Time-overcurrent overload protection for the motor.
10. Inverse characteristic time-overcurrent overload protection for the motor sized in accordance with NEC requirements.
11. Drive shall be capable of withstanding random application of an output short circuit without damage to drive components or fuses.
12. Input phase loss and undervoltage protection.
13. Torque/current limit control which will slow the motor without tripping when the motor is subjected to an overload, or slow the acceleration ramp when accelerating a high inertia load.
14. Drives shall be capable of “riding through” a momentary loss of power for up to 2 seconds.
15. AC line reactors in the drive cabinet for protection against line notching and surges without requirement for an input isolation transformer.
16. Power factor shall be minimum 95% at all speeds and loads.

17. Each drive shall have the following status and troubleshooting diagnostic features:

    a. Auto restart in “auto” mode. Certain drive faults shall be selectable to bypass the auto restart feature. Auto restart manual shall only be attempted 5 times.
    b. Exterior drive door mounted devices shall include”

        1) “Power On” pilot light.
        2) “VFD Run” pilot light.
        3) % full load digital display.
        4) Output frequency and/or % speed digital meter.

    c. Indicator lights on each power module to indicate correct operation (or failure) of individual owner switching devices.
    d. DRIVE/OFF/LINE test switch.

18. UL listed or ETL listed.
19. Minimum and maximum speed adjustment.
20. Factory Tests: The VFD shall be tested with the system logic and given complete factory tests including simulated operation.

    a. Provide certification this test has been made for the particular units shipped for this job.

21. Field Adjustments: Independent acceleration/deceleration rates: 0.5 – 120 seconds.
22. Provide a maximum of 1000-Volts at the motor terminals.
23. Provide LAN card connection to interface with Building Automation System. Coordinate control protocols with BMS contractor.
24. Where the VFD is used as part of a smoke control or pressurization systems:

    a. Provide a minimum of (6) six auxiliary contact(s) for connection to smoke control system.
    b. VFD to be UUKL864 listed for smoke management.
    c. Provide torque indication output on drive to verify airflow.
    d. VFD shall not be equipped with bypass.

E. All variable frequency drives (except those used in smoke control systems) shall be equipped with a manual bypass device to allow for total isolation of the drive unit for service while providing for temporary operation of the motor. This shall include:

1. A main disconnect switch in the bypass enclosure with a door interlock handle. This disconnect shall provide positive shutdown of all power to both the bypass circuitry and the VFD.

    a. For motors on emergency, or life safety systems, the bypass shall be in a separate compartment from the VFD. The installation shall allow for removal of the VFD while maintaining operation of the load.

2. With the “H-O-A” switch in the “OFF” position, the run circuit will be open and the VFD will not operate.
3. A VFD output contactor and a constant speed contactor.
4. A three pole motor overload relay with heaters connected to shut down the motor in both the VFD and bypass modes.
5. A control relay and terminal blocks which will allow two-wire, start-stop control of the motor from a single remote contact in both VFD and BYPASS (AUTO) modes of operation.

6. A control relay and terminal blocks to allow connection of remote interlock shutdown contacts such as freezestats, smoke detectors, etc. When this interlock loop is opened, operation of the motor shall be disabled in both VFD and bypass modes.
7. A three position selector switch shall be provided, VFD-OFF-BYPASS.
8. Indicator lights on the face of the bypass panel shall be provided as follows: Indicators shall be long life neon or transformer type incandescent types.

    a. “POWER ON”
    b. “MOTOR ON VFD”
    c. “MOTOR ON BYPASS CONTROL”
    d. “MOTOR OVERLOAD”
    e. “INTERLOCK SHUTDOWN”

9. 120V control power transformer with fused secondary and primary. Bypass mode operation shall be independent of VFD control power.
10. VFD output contactor shall be wired to allow a controlled VFD deceleration ramp to stop.
11. Panel shall be arranged to allow power-off maintenance of VFD while motor is operation on bypass. Bypass circuitry in the same compartment as the VFD will not be allowed.

F. In addition to the above feature all drives shall have the following additional features:

1. Catch-a-spinning load capability.
2. Critical speed avoidance capability.
3. Where the building walls are not suitable for mounting drives a floor stand kit shall be provided.
4. Where required by Division 23 09 01, provide output isolator to provide VFD signal operation of frequency, and current to an isolated 4-20 mA signal for transmission to the building automation system for monitoring capability.

G. For variable frequency drives serving multiple motors, the following shall be provided:

1. Provide motor contactors for each motor for drives serving more than one motor, each contactor shall have auxiliary contacts to prevent drive damage if remote motor disconnect switch is open of closed.
2. Each drive shall have contactors for each motor it serves with individual thermal overload protection for each motor and H-O-A motor select switch.
3. All multiple motor variable speed controllers shall be capable of operating even if one of the motors is off.

H. For drive manufacturers who use portable test meter for diagnostics, provide not less than one test meter for each model or type used. Meters shall be supplied to the Owner upon completion of the project.

I. Provide one complete set of spare fuses for all variable speed controllers.

J. Interlock all disconnects with variable speed drive so variable speed drive opens before disconnect opens to prevent damage to the drive.

PART 3 - EXECUTION

3.1 GENERAL

A. Deliver units to installer of electrical work. Provide installation and wiring instruction and diagrams.

B. Provide wiring control diagrams and instructions to installer of automatic temperature controls.

C. Provide factory representative at start-up to check installation and instruct Owner.

END OF SECTION

This page is intentionally left blank.

SECTION 23 05 48 - VIBRATION CONTROL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplemental Conditions of the Construction Contract, and Division 1 Specification Sections (General Requirements), apply to this Section.

1.2 DESCRIPTION

A. Furnish and install vibration control devices, materials, and related items. Perform all work as shown on the drawings and as specified herein to provide complete vibration isolation systems in proper working order.

1.3 MATERIAL AND EQUIPMENT

A. Design Basis: Mason Industries

B. Alternate Manufacturers:

1. Amber/Booth Co.
2. California Dynamics
3. Kinetics
4. Korfund Dynamics Corp.
5. Vibration Eliminator Co.
6. Vibration Mountings & Controls, Inc.
7. Vibro-Acoustics

C. Unless otherwise specified, supply only new equipment, parts and materials.

1.4 QUALITY ASSURANCE

A. Coordinate the size, location, and special requirements of vibration isolation equipment and systems with other trades. Coordinate plan dimensions with size of housekeeping pads.

B. Provide vibration isolators of the appropriate sizes, with the proper loading to meet the specified deflection requirements.

C. Supply and install any incidental materials needed to meet the requirements stated herein, even if not expressly specified or shown on the drawings, without claim or additional payment.

D. Verify correctness of equipment model numbers and conformance of each component with manufacturer’s specifications.

E. Should any rotating equipment cause excessive noise or vibration, the Contractor shall be responsible for rebalancing, realignment, or other remedial work required to reduce noise and vibration levels. Excessive is defined as exceeding the manufacturer's specifications for the unit in question.

1.5 SUBMITTALS

A. Reference Division 1.

B. Prior to ordering any products, submit shop drawings or the items listed below. The shop drawings must be complete when submitted and must be presented in a clear, easily understood form. Incomplete or unclear presentation of shop drawings may be reason for rejection of the submittal.

1. A complete description of products to be supplied, including product data, dimensions, specifications, and installation instructions.
2. Detailed selection data for each vibration isolator supporting equipment, including:

    a. The equipment identification mark;
    b. A cut sheet of the isolated equipment showing equipment support points and operating weight at each point.
    c. The isolator type;
    d. The actual load;
    e. The static deflection expected under the actual load;
    f. Specified minimum static deflection;
    g. The additional deflection-to-solid under load;
    h. The ratio of spring height under load to spring diameter.

3. Steel rails, steel base frames, and concrete inertia bases showing all steel work, reinforcing, vibration isolator mounting attachment method, and location of equipment attachment bolts.
4. Special details necessary to convey complete understanding of the work to be performed.

PART 2 - PRODUCTS

2.1 VIBRATION ISOLATION MOUNT TYPES

A. General:

1. All metal parts of vibration isolation units installed out-of-doors shall be cold-dip galvanized, cadmium plated, or neoprene coated after fabrication. Galvanizing shall meet ASTM Salt Spray Test Standards and Federal Test Standard No. 14.
2. All isolators installed out-of-doors shall have base plates with bolt holes for fastening the isolators to the support members.
3. Isolator types are scheduled to establish minimum standards. At the Contractor's option, laborsaving accessories can be an integral part of isolators supplied to provide initial lift of equipment to operating height, hold piping at fixed elevations during installation and initial system filling operations, and similar installation advantages. Accessories must not degrade the vibration isolation system.

4. Static deflection of isolators shall be as provided in SECTION 3 - EXECUTION. All static deflections stated are the minimum acceptable deflection for the mounts under actual load. Isolators selected solely on the basis of rated deflections are not acceptable and will be disapproved.

B. Type FSN (Floor Spring and Neoprene)

1. Spring isolators shall be freestanding and laterally stable without any housing. Spring diameter shall be not less than 0.8 of the compressed height of the spring at the rated load. Springs shall have a minimum additional travel-to-solid equal to 50% of the rated deflection. Springs shall be so designed that the ratio of horizontal stiffness to vertical stiffness is approximately one (1). All mounts shall have leveling bolts.
2. Either the spring element in the isolator shall be set in a neoprene cup and have a steel washer to distribute the load evenly over the neoprene, or each isolator shall be mounted on a Type NP isolator. If the NP isolator is used, provide a rectangular bearing plate of appropriate size to load the pad uniformly within the manufacturer's recommended range.
3. If the basic spring isolator has a neoprene friction pad on its base and a NP isolator is to be added to the base, a galvanized steel, stainless steel or aluminum plate shall be used between the friction pad and the NP isolator. If the isolator is outdoors, the plate shall not be made of galvanized steel. The NP isolator, separator plate and friction pad shall be permanently adhered to one another and to the bottom of the bearing plate.
4. If the isolator is to be fastened to the building structure and Type NP isolator is used under the bearing plate, neoprene grommets shall be provided for each bolt hole in the base plate. Bolt holes shall be properly sized to allow for grommets. The hold down bolt assembly shall include washers to distribute load evenly over the grommets. Bolts and washers are to be galvanized.
5. Type FSN isolators shall be Mason Type SLF with the appropriate neoprene pad (if used) selected from Type NP or approved equal.

C. Type FSNTL (Floor Spring and Neoprene Travel Limited)

1. Spring isolators shall be freestanding and laterally stable without any housing. Spring diameter shall not be less than 0.8 of the compressed height of the spring at the rate load. Spring shall have a minimum additional travel-to-solid equal to 50% of the rated deflection. Springs shall be so designed that the ratio of horizontal stiffness to vertical stiffness is approximately one (1). All mounts shall have leveling bolts. All mounts shall have vertical travel limit stops to control extension when weight is removed. The travel limit stops shall be capable of serving as blocking during erection of the equipment. A minimum clearance of ¼" shall be maintained around restraining bolts and between the limit stops and the spring to avoid interference with the spring action.
2. Either the spring element in the isolator shall be set in a neoprene cup and have a steel washer to distribute the load evenly over the neoprene, or each isolator shall be mounted on a Type NP isolator. If the NP isolator is used, provide a rectangular bearing plate of appropriate size to load the pad uniformly within the manufacturer's recommended range. If the basic spring isolator has a neoprene friction pad on its base and a NP isolator is to be added to the base, a galvanized steel, stainless steel or aluminum plate shall be used between the friction pad and the NP isolator. If the isolator is outdoors, the plate shall not be made of galvanized steel. The NP isolator, separator plate, and friction pad shall be permanently adhered to one another and to the bottom of the bearing plate.
3. If the isolator is to be fastened to the building structure and Type NP isolator is used under the bearing plate, neoprene grommets shall be provided for each bolt hole in the base plate. Bolt holes shall be properly sized to allow for grommets. Hold down assembly shall include washers to distribute load evenly over the grommets. Bolts and washers are to be galvanized.
4. Type FSNTL isolators shall be Mason Type SLR with the appropriate neoprene pad (if used) selected from Type NP or approved equal.

D. Type FN (Floor Neoprene)

1. Neoprene isolators shall be neoprene-in-shear type with steel reinforced top and base. All metal surfaces shall be covered with neoprene. The top and bottom surfaces shall be ribbed. Bolt holes shall be provided in the base and the top shall have a threaded fastener. The mounts shall include leveling bolts that may be rigidly connected to the equipment.
2. Type FN isolators shall be Mason Type ND or approved equal.

E. Type FNC (Floor Neoprene Chiller)

1. Neoprene isolators shall be double neoprene-in-shear type with steel reinforced top intermediate plates and base. Neoprene elements shall be ¾". Steel plates shall be ¼" and the top and bottom plates shall be ribbed. Bolt holes shall be provided in the base and the top shall have a threaded fastener. The mounts shall include leveling bolts that may be rigidly connected to the equipment.
2. Type FNC isolators shall be Mason Type ND: Fabricate of type "Super W" pads, similar to Type ND otherwise.

F. Type NP (Neoprene Pad)

1. Neoprene pad isolators shall be one layer of ¼" to 3/8" thick ribbed or waffled neoprene. The pads shall be sized so that they will be loaded within the manufacturer's recommended range.
2. Type NP isolators shall be Mason Type W or approved equal.

G. Type DNP (Double Neoprene Pad)

1. Neoprene pad isolators shall be formed by two layers of ¼" to 3/8" thick ribbed or waffled neoprene, separated by a galvanized steel, stainless steel or aluminum plate. If the isolator is outdoors, the plate shall not be made of galvanized steel. These layers shall be permanently adhered together. The pads shall be sized so that they will be loaded within the manufacturer's recommended range.
2. Type DNP isolators shall be Mason Type WSW or approved equal.

H. Type HSN (Hanger Spring and Neoprene)

1. Vibration isolation hangers shall consist of a free standing and laterally stable steel spring and a neoprene element in series, contained within a steel housing. Spring diameters and hanger housing lower hole sizes shall be large enough to permit the hanger rod to swing through a 30º arc before contacting the housing. Hangers shall provide a means to adjust hanger elevation under load. Spring diameter shall be not less than 0.8 of the compressed height of the spring at the rated load. Spring elements shall have a minimum additional travel-to-solid equal to 50% of the rated deflection. The neoprene element shall be designed to have a 0.3" minimum static deflection. The deflection of both the spring element and the neoprene element shall be included in determining the overall deflection of Type HSN isolators.
2. Type HSN isolators shall be Mason Type P30N or approved equal.

I. Type HN (Hanger Neoprene)

1. Vibration isolation hangers shall consist of a neoprene-in-shear element contained within a steel housing. A neoprene neck bushing shall be provided where the hanger rod passes through the hanger housing to prevent the rod from contacting the hanger

housing. The diameter of the hole in the housing shall be sufficient to permit the hanger rod to swing through a 30º arc before contacting the hanger housing.
2. Type HN isolators shall be Mason Type HD or approved equal.

2.2 EQUIPMENT BASES

A. Type BIB (Base - Inertia Base)

1. Concrete inertia bases shall be formed of stone-aggregate concrete (150 lbs./cu.ft.) and appropriate steel reinforcing cast between welded or bolted perimeter structural steel channels. Inertia bases shall be built to form a rigid base which will not twist, deform, deflect, or crack in any manner which would negatively affect the operation of the supported equipment or the vibration isolation mounts. Inertia bases shall be adequately sized to support basic equipment units and motors plus any associated pipe elbow supports, duct elbow supports, electrical control elements, or other components closely related and requiring resilient support in order to prevent vibration transfer to the building structure. Inertia base depth shall be at least 1/12 the longest dimension of the inertia base, but not less than 6” nor more than 12”. The base footprint shall be large enough to provide stability for supported equipment. Inertia bases shall include side-mounting brackets for attachment to vibration isolators. Mounting brackets shall be located on the sides of the base that are parallel to the axis of rotation of the supported equipment.
2. The steel frame and reinforcement shall be supplied by the vibration isolator manufacturer. Concrete may be provided by the General Contractors.
3. Frame and reinforcement for Type BIB bases shall be Mason Type KSL or approved equal.

B. Type BC-1 (Base - Curb)

1. Curb type isolation bases shall be a prefabricated assembly consisting of an extruded aluminum frame and steel spring isolation system that fits over the roof curb and under the isolated equipment. The aluminum frame shall be sufficiently rigid to support the equipment load without detrimental twist or deflection. Spring isolators shall be selected and positioned along the curb to achieve the minimum static deflection called for in the schedule. The static deflection shall be constant around the entire periphery of the base. Springs shall be free standing, laterally stable with a diameter of not less than 0.8 times the compressed height, and have additional travel-to-solid that is at least 50% of the rated deflection. Resilient neoprene snubbers shall be provided at the corners of the base to limit the movement of the equipment under wind load to ¼”.
2. The isolation curb base shall be made weather tight by sealing all around the periphery with closed cell neoprene or flexible vinyl. This shall in no way inhibit the vibration isolation of the spring elements. A closed cell sponge gasket or field caulking shall be used between the equipment unit and the isolation curb base and between the isolation curb and roof curb to form a weather-tight seal.
3. Each spring isolator used in the curbs shall be weather protected as described above.
4. Type BC-1 vibration isolation curb bases shall be Mason Type CMAB or approved equal.

2.3 RESILIENT LATERAL GUIDES

A. These units shall either be a standard product of the vibration isolation mounting manufacturer, or be custom fabricated from standard components. These units shall incorporate neoprene isolation elements similar to Type FN which are specifically designed to provide resilient lateral bracing of duct or pipe risers.

B. Resilient lateral guides shall be Mason Type ADA.

2.4 FLEXIBLE DUCT CONNECTORS

A. Refer to section 23 33 00 Ductwork Accessories for flexible duct connector specifications.

B. The clear space between connected parts shall be a minimum of 3” and the connection shall have 5” minimum of slack material.

2.5 FLEXIBLE PIPE CONNECTIONS

A. Flexible pipe connection shall be fabricated of multiple plies of nylon cord, fabric, and neoprene; and shall be vulcanized so as to become inseparable and homogeneous. Flexible connections shall be formed in a double sphere shape, and shall be able to accept compressive, elongative, transverse, and angular movements.

B. The flexible connections shall be selected and specially fitted, if necessary, to suite the system temperature, pressure, and fluid type. In addition, suitable flexible connections should be selected which do not require rods or cables to control extension of the connector.

C. Connectors for pipe sizes 2” or smaller shall have threaded female union couplings on each end. Larger sizes shall be fitted with metallic flange couplings.

D. Flexible pipe connections shall be Mason Industries Type SFDEJ; Metraflex DoubleSphere; or Amber/Booth Type 2600 or 2655.

2.6 RESTRAINTS

A. Snubber:

1. Snubbers shall be custom fabricated using Type FN isolators mounted to steel angle brackets. The steel angle shall be sufficiently rigid and the mounting sufficiently secure to resist excessive movement of equipment during on-off cycle.

B. Thrust Restraints:

1. Thrust restraints shall consist of a spring element in series with a neoprene pad. The unit shall be designed to have the same deflection due to thrust-generated loads as specified for the isolators supporting the equipment. The spring element shall be contained within a steel frame and be designed so it can be precompressed at the factory to allow for a maximum of 1/4” movement during starting or stopping of the equipment. Allowable movement shall be field-adjustable.
2. The assembly shall be furnished complete with rods and angle brackets for attachment to both the equipment and the adjacent fixed structural anchor.
3. Thrust restraints shall be Mason Industries Type WB, Kinetics Noise Control Type HSR, Amber/Booth Type TRK or an equal product of the manufacturer supplying the isolators.

2.7 GROMMETS

A. Grommets shall either be custom made by combining a neoprene washer and sleeve, be Isogrommets as manufactured by MBIS, Inc. (Bedford Heights, Ohio), or be Series W by Barry

Controls (Watertown, Mass.). Grommets shall be sized so that they will be loaded within the manufacturer's recommended load range. Grommets shall be specially formed to prevent both from directly contacting the isolator base plate.

2.8 ACOUSTICAL SEALANT

A. Sealants for acoustical purposes as described in this specification shall be silicone or one of the non-setting sealants indicated below:

Acoustical Sealant	D.A.P
BR-96	Pecora
Acoustical Sealant	Tremco
Acoustical Sealant	U.S.G.

PART 3 - EXECUTION

3.1 APPLICATION

A. General:

1. Refer to SECTION 2 - PRODUCTS of this specification for vibration isolation devices identified on the drawings or specified herein.
2. The static deflection values of all isolators specified herein are the minimum acceptable deflections for the mounts under actual load. Isolators selected solely on the basis of rated deflection are not acceptable and will be disapproved.

B. Major Equipment:

1. Unless otherwise shown or specified, all floor-mounted major equipment shall be set on 4" high concrete housekeeping pads. See architectural or structural drawings for details.
2. Types and minimum static deflections of vibration isolation devices for major equipment items shall be as scheduled on the drawings or specified hereunder.
3. Flexible duct connectors shall be installed at all fan unit intakes, fan unit discharges, and wherever else shown on the drawings unless noted otherwise. Individual fan units with motors rated at less than 3/4 hp do not require a flexible connector. Do not install flexible duct connectors in grease exhaust systems.
4. Flexible pipe connections shall be installed at all pipe connections to vibration-isolated equipment in the positions shown on the drawings.
5. Thrust restraints shall be installed on all floor-mounted fans developing 4" or more of static pressure, all suspended fans developing 2" or more static pressure, and wherever else called for on the drawings.
6. Snubbers shall be installed as called for on the drawings.

C. Miscellaneous Mechanical Equipment:

1. Miscellaneous pieces of mechanical equipment such as converters, pressure reducing stations, dryers, strainers, storage tanks, condensate receiver tanks, and expansion tanks which are connected to isolated piping system shall be vibration isolated from the building structure by Type NP or Type HN isolators (selected for 0.1" static deflection) unless their position in the piping system requires a higher degree of isolation as called for under Pipe Isolation.

D. Pipes:

1. All chilled water, condenser water, heating water, drain and engine exhaust piping that is connected to vibration-isolated equipment shall be isolated from the building structure within the following limits:

    a. Within mechanical rooms.
    b. And within 50’ total pipe length of connected vibration-isolation equipment (chillers, pumps, air handling units, pressure reducing stations, etc.):

2. Piping shall be isolated from the building structure by means of vibration isolation mounts, resilient pipe guides, and resilient penetration sleeve/seals.
3. Isolators for the first three support points adjacent to connected equipment shall achieve one half the specified static deflection of the isolators supporting the connected equipment. When the required static deflection of these isolators is greater than 1/2” Type FSN or HSN isolators shall be used. When the required static deflection is less than or equal to 1/2”, Type FN or HN isolators shall be used. All other pipe support isolators within the specified limits shall be either Type FN or HN achieving at least 1/4” static deflection.
4. Where lateral support of pipe risers is required within the specified limits, this shall be accomplished by use of resilient lateral supports.
5. Pipes within the specified limits that penetrate the building construction shall be isolated from the building structure by use of resilient penetration sleeve/seals.
6. Provide flexible pipe connections on all piping connected to all isolated equipment and wherever shown on the drawings.

3.2 INSTALLATION OF VIBRATION ISOLATION EQUIPMENT

A. General:

1. Locations of all vibration isolation devices shall be selected for ease of inspection and adjustment as well as for proper operation.
2. Installation of vibration isolation equipment shall be in accordance with the manufacturer’s instructions.

B. Isolation Mounts:

1. All vibration isolators shall be aligned squarely above or below mounting points of the supported equipment.
2. Isolators for equipment with bases shall be located on the sides of the bases, which are parallel to equipment shaft unless this is not possible because of physical constraints.
3. Locate isolators to provide stable support for equipment, without excess rocking. Consideration shall be given to the location of the center of gravity of the system and the location and spacing of the isolators. If necessary, a base with suitable footprint shall be provided to maintain stability of supported equipment, whether or not such a base is specifically called to herein.
4. If a housekeeping pad is provided, the isolators shall bear on the housekeeping pad and the isolator base plates shall rest entirely on the pad.
5. Hanger rods for vibration-isolated support shall be connected to structural beams or joists, not the floor slab between beam joists. Provide suitable intermediate support members as necessary.
6. Vibration isolation hanger elements shall be positioned as high as possible in the hanger rod assembly, but not in contact with the building structure, and so that the hanger housing may rotate a full 360º about the rod axis without contacting any object.
7. Parallel running pipes may be hung together on a trapeze, which is isolated from the building. Isolator deflections must be the greatest required by the provisions for pipe

isolation for any single pipe on the trapeze. Do not mix isolated and non-isolated pipes on the same trapeze.

8. Pipes, ducts and equipment shall not be supported from other pipes, ducts and equipment.
9. Resiliently isolated pipes, ducts and equipment shall not come in rigid contact with the building construction or rigidly supported equipment.
10. The installed and operating heights of equipment vibration-isolated with Type FSNTL isolators shall be identical. Limit stops shall be out of contact during normal operation. Adjust isolators to provide 1/4” clearance between the limit stop brackets and the isolator top plate, and between the travel limit nuts and travel limit brackets.
11. Adjust all leveling bolts and hanger rod bolts so that the isolated equipment is level and in proper alignment with connecting ducts or pipes.

C. Bases:

1. No equipment unit shall bear directly on vibration isolators unless its own frame is suitably rigid to span between isolators and such direct support is approved by the equipment manufacturer. This provision shall apply whether or not a base frame is called for on the schedule. In the case that a base frame is required for the unit because of the equipment manufacturer’s requirements and is not specifically called for on the equipment schedule, a base frame recommended by the equipment manufacturer shall be provided at no additional expense.
2. Unless otherwise indicated, there is to be a minimum operating clearance of 1” between inertia bases or steel frame bases and the floor beneath the equipment. Position isolator mounting brackets and adjust isolators so that the required clearance is maintained. The clearance space shall be checked by the Contractor to ensure that no construction debris has been left to short circuit or restrict the proper operation of the vibration isolation system.

D. Flexible Duct Connections:

1. Sheet metal ducts and plenum opening shall be squarely aligned with the fan discharge, fan intake, or adjacent duct section prior to installation of the flexible connection, so the clear length is approximately equal all the way around the perimeter. Flexible duct connections shall not be installed until this provision is met. There shall be no metal-to-metal contact between connected sections, and the fabric shall not be stretched taut.

E. Flexible Pipe Connections:

1. Install flexible pipe connections in strict accordance with the manufacturer’s instructions.

F. Restraints:

1. Snubbers shall be adjusted to clear the equipment base and to provide lateral restraint during on-off cycling, but be out of contact during normal operation of the equipment.
2. Thrust restraints shall be attached at the centerline of thrust and symmetrically on each side of the unit. The two rods of the thrust restraint shall be axially aligned. This may require modified brackets or standoffs. The body of the thrust restraint shall not come in contact with the connected elements. Thrust restraints shall be adjusted to constrain equipment movement to the specified limit.

G. Resilient Penetration Sleeve/Seals:

1. Maintain an airtight seal around the penetrating element and prevent rigid contact between the penetrating element and the building structure. Fit the sleeve tightly to the building construction and seal airtight on both sides of the construction penetrated with acoustical sealant.

    a. At minimum, provide resilient penetration seals at all Mechanical, Equipment and Fan Room Penetrations.

3.3 ISOLATOR SCHEDULE

UNIT	ISOLATOR TYPE	MINIMUM STATIC DEFL.(IN.)	BASE TYPE	REMARKS
Air Handling Units	FSN (Note 1)	1.5		Thrust restraints if internally isolated.
Inline Fans	HSN	2		
Fan Coil Units	(Note 2)	(Note 2)		
Chillers	FNC	0.35		Slab on Grade
Pumps (Basemount)	BIB (Note 3)	1.5		
Boiler	FN	0.35		
Utility Fans	FSNTL	2		

Notes:

1. External isolator may be omitted if units have internally isolated fans and no other rotating or reciprocating components.
2. Isolators for fan coil units should be either HSN with 0.75” minimum static deflection or be equivalent to Mason Industries Type HN with 0.35” minimum static deflection.
3. For slab-on-grade installations isolators are not required. Refer to Section 23 21 23.

END OF SECTION

SECTION 23 05 53 - MECHANICAL IDENTIFICATION

PART 1 - GENERAL

1.1 SUBMITTALS

A. Submit manufacturer's product data on the following:

1. Plastic Pipe Markers and method of application.
2. Engraved Plastic Laminate Sign.

B. LEED:

1. In addition to meeting the general requirements for VOC emissions, detailed in the LEED Reference Guide, on-site wet-applied products must not contain excessive levels of VOCs, for the health of the installers and other trades workers who are exposed to these products. To demonstrate compliance, a product or layer must meet the following requirements, as applicable. Disclosure of VOC content must be made by the manufacturer. Any testing must follow the test method specified in the applicable regulation.

    a. All paints and coatings wet-applied on site must meet the applicable VOC limits of the California Air Resources Board (CARB) 2007, Suggested Control Measure (SCM) for Architectural Coatings, or the South Coast Air Quality Management District (SCAQMD) Rule 1113, effective June 3, 2011.
    b. All adhesives and sealants wet-applied on site must meet the applicable chemical content requirements of SCAQMD Rule 1168, July 1, 2005, Adhesive and Sealant Applications, as analyzed by the methods specified in Rule 1168. The provisions of SCAQMD Rule 1168 do not apply to adhesives and sealants subject to state or federal consumer product VOC regulations.

PART 2 - PRODUCTS

2.1 GENERAL

A. Except as otherwise indicated, provide manufacturer's standard products.

B. Where more than a single type is specified for an application, selection is Installer's option, but provide a single selection for each application.

2.2 PLASTIC PIPE MARKERS (TYPE A)

A. Provide manufacturer's standard pre-printed, flexible or semi-rigid, permanent, color-coded, plastic-sheet pipe markers, complying with ANSI A13.1.

B. For Pipes Less Than Six Inches (including insulation if any): Provide full-band pipe markers, extending 360º around pipe at each location, fastened by one of the following methods:

1. Snap-on application of pre-tensioned semi-rigid plastic pipe marker.

2. Adhesive lap joint in pipe marker overlap.
3. Taped to pipe (or insulation) with color-coded plastic adhesive tape, not less than ¾" wide; full circle at both ends of pipe marker, tape lapped 1-½".

C. For Pipes Six Inches and Larger (including insulation if any): Provide either full-band or strip-type markers, but not narrower than 3 x letter height, taped to pipe (or insulation) with color-coded plastic adhesive tape, not less than 1-½" wide; full circle at both ends of pipe marker, tape lapped 3".

D. Lettering: Manufacturer's pre-printed wording which conforms to contract document system descriptions.

E. Arrows: Print each pipe marker with arrows indicating direction of flow, either integrally with piping system service lettering or as a separate unit of plastic (to accommodate both directions).

2.3 STENCILING (TYPE B)

A. Using a color contrasting to the surface to identify, spray or brush paint through neatly cut stencils.

B. Lettering shall conform to wording on contract documents. Size shall be in accordance with ANSI A13.1.

2.4 BACKGROUND COLOR AND STENCILING (TYPE C)

A. In addition to the requirements above, paint a background color band in accordance with ANSI A13.1.

2.5 VALVES TAGS

A. Brass Valve Tags: Provide manufacturer's standard 19 ga brass tag; approximately 1-½" round with ½" high, black-filled numbers and 3/16" top hole.

1. Numbers shall be sequential in accordance with schedule below.
2. Provide separate numbering for each legend sequence. Provide separate sequences for the following:

    a. Gas (GAS)
    b. Plumbing (PLBG)
    c. Heating Water (HTG)
    d. All other systems (No legend)

B. Valve Tag Fasteners: Manufacturer's standard chain (wire link or beaded type), or S-hooks.

2.6 VALVE SCHEDULE

A. Provide schedule for each piping system, as defined on the drawings, and below, typewritten and reproduced on 8-½" x 11" bond paper.

B. Tabulate valve number, piping system, system legend (as shown on tag), location of valve (room or space), and variations for identification (if any).

C. Provide piping schematic for each system as defined below in Part 3.

D. In addition to mounted copies, furnish extra copies for maintenance manuals as specified.

E. Valve Schedule Frames: For each page of the valve schedule, provide a glazed frame, with screws for removable mounting on masonry walls.

2.7 ENGRAVED PLASTIC-LAMINATE SIGNS

A. General: Provide engraving stock melamine plastic laminate, 1/16” thick, black with white core (letter color).

B. Fastening:

1. Screws
2. Rivets
3. Permanent Adhesive

C. Lettering and Graphics:

1. Coordinate names, abbreviations and other designations used in the mechanical identification work, with the corresponding designations shown, specified or scheduled in the construction documents.
2. In addition, for heating or cooling units and exhaust fans, identify area served.

PART 3 - EXECUTION

3.1 GENERAL

A. Where identification is to be applied to surfaces which require insulation, painting or other covering or finish, install identification after completion of covering and painting.

B. Install identification prior to installation of acoustical ceilings and similar removable concealment.

3.2 DUCTWORK IDENTIFICATION

A. General: Identify air supply, return, exhaust, intake and relief ductwork with stenciled signs and arrows, showing ductwork service and direction of flow, in black or white, whichever provides most contrast with ductwork color.

B. Location: In each space where ductwork is exposed, or concealed only by removable ceiling system, locate signs near points where ductwork originates or continues into concealed enclosures (shaft, underground or similar concealment), and at 50’ spacing along exposed runs.

C. Access Doors: Provide stenciled or plastic laminate type signs on each duct or equipment-mounted access door in ductwork and housings, indicating the purpose of the access (to what equipment) and other maintenance and operating instructions, and appropriate safety and procedural information.

3.3 PIPING SYSTEM IDENTIFICATION

A. General: Install pipe markers on piping of the following systems and include arrows to show normal direction of flow.

1. Domestic water piping (hot, cold, tempered; 120º hot, 180º hot, hot water recirculating, etc.).
2. Plumbing vent and sanitary (above grade) piping.
3. Storm piping.
4. Heating water piping (supply and return).
5. Chilled water piping (supply and return).
6. Refrigerant piping (suction, liquid, hot gas bypass).
7. Condensate piping.
8. Fire protection.

B. Locate pipe markers and color bands, as follows, on all piping exposed to view, above an accessible ceiling, and in accessible maintenance spaces (including chases and near access panels). In spaces exposed to view in public areas, effort is to be made to coordinate exact locations with architect.

1. Near each valve and control device.
2. Near each branch, excluding short take-offs for fixtures and terminal units. Mark each pipe at branch, where there could be a question of flow pattern.
3. Near locations where pipes pass through walls, floors, or ceilings, or enter non-accessible enclosures.
4. Near major equipment items and other points of origination and termination.
5. Spaced intermediately at maximum spacing of 50’ along each piping run.
6. Within 6’ of access doors above otherwise non-accessible ceilings and chases.

C. Type:

1. Normally exposed to view - Type A or C.
2. Normally concealed from view - Type B.

3.4 VALVE IDENTIFICATION

A. Provide valve tag on every valve, cock and control device in each piping system; exclude check valves, valves within factory fabricated equipment units, plumbing fixtures faucets, hose bibs, and shut-off valves at plumbing fixtures, HVAC terminal devices and similar rough-in connections of end-use fixtures and units. List each tagged valve in valve schedule for each piping system.

B. Mount framed valve schedules with piping schematics where directed by Architect.

C. Identify each valve tagged on as-built drawings.

3.5 MECHANICAL EQUIPMENT IDENTIFICATION

A. Install an engraved plastic laminate sign on or near each scheduled item of mechanical equipment.

B. Provide engraved plastic laminate nameplate on every new piece of equipment not already provided with one in accordance with Section 23 05 02 of the specifications.

C. Identify area served, if applicable.

3.6 NON-POTABLE WATER IDENTIFICATION

A. Provide an engraved plastic laminate sign.

1. Legend: “Non-Potable Water”.
2. Location: At each outlet of piping downstream of backflow preventer, (e.g. Boiler Room hose bibb).

END OF SECTION

This page is intentionally left blank.

SECTION 23 05 93 - TEST-ADJUST-BALANCE

PART 1 - GENERAL

1.1 RESPONSIBILITY

A. The Balancing Contractor shall be a sub-contractor, directly working for the General Contractor.

B. The Balancing Contractor shall not be a sub-contractor of any other Division 21, 22 or 23 Contractor.

1.2 QUALITY ASSURANCE

A. Qualification:

1. Work shall be done by a firm certified by the National Environmental Balancing Bureau (NEBB), or the Associated Air Balance Council (AABC), or the firm shall have technicians certified by the “National Training Fund Sheet Metal & Air Conditioning Industry”.
2. The firm shall be an independent testing and balancing form specializing in testing and balancing of environmental systems.
3. The firm shall have an experience record of not less than five (5) years of experience in the TAB industry.

B. Industry Standards: Comply with the following:

1. HVAC Systems-Testing, Adjusting, Balancing published by Sheetmetal and Air Conditioning Contractors National Association, Inc. (SMACNA).
2. Procedural Standards for Testing, Adjusting, Balancing of Environmental Systems published by National Environmental Balancing Bureau. (NEBB).
3. ASHRAE Systems Handbook. Testing, Adjusting and Balancing.

C. Registration: Work shall be done under the supervision of a professional engineer registered in Maryland. Engineer shall be available for all meetings and interpretation of all materials in the report.

D. Pre-qualification of TAB Contractor.

1. The firm must have experience and qualifications satisfactory to the consulting mechanical engineer and must be accepted by them prior to bidding.
2. Firms desiring approval to provide work under this section shall submit a booklet indicating procedures and data forms that they would use in the performance of the work.
3. Submittals shall be in accordance with Division 1.
4. Only firms which have been approved by the mechanical engineer prior to bid date may provide work under this section.

PART 2 - PRODUCTS – NOT USED

PART 3 - EXECUTION

3.1 GENERAL

A. Sequence work to commence after completion of system and start-up procedures and schedule completion of work before Substantial Completion of Project.

B. Examine the installed work and conditions under which testing is to be done to ensure that work has been completed, cleaned and is operable.

C. Notify the Contractor in writing of conditions detrimental to the proper completion of the test-adjust-balance work.

1. Do not proceed with the work until unsatisfactory conditions have been corrected.
2. Provide Engineer/Architect with a copy of the notification.

D. Adjust air flows and heating water systems to within 10% of values shown. Adjust chilled water systems to within 5% of values shown. If design flows cannot be obtained within specified limits the Balancing Contractor will perform the following (at the minimum):

1. Measure and record major pressure drops in the system.
2. Consult with the Engineer and Installer as required.
3. Upon receiving written directions to proceed and after any corrections are performed, re-balance affected portion of system.

E. Optimization: Work closely with the Section 23 09 00 contractor to optimize setpoints.

1. Establish the minimum air static pressure or water differential pressure for variable or bypass flow system.
2. Establish the position of minimum outside air dampers, damper/valve and sequencing relays.

F. Calibration: Be responsible for calibration of flow measurement devices used as input to the temperature control system. All air systems flow measurement stations including VAV terminals shall be calibrated against a pitot tube traverse or air diffuser capture hood. Balancing contractor shall assure accuracy of all flow measurement devices or shall report on their failure to be accurate.

G. Patch holes in insulation, ductwork and housings, which have been cut or drilled for test purposes, in a manner recommended by the original Installer.

H. Make all final readings for each system at the same time, and after all adjustments have been made.

I. Mark equipment settings, including damper control positions, balancing cocks, circuit setters, valve indicators, fan speed control settings and similar controls and devices, to show final settings at completion of test-adjust-balance work.

1. Mark with paint or other suitable permanent identification material.

J. Check all new thermal overloads.

1. Identify improperly protected equipment in report.

3.2 AIR SYSTEMS

A. Scope: All air systems are to be balanced.

B. Before any adjustments are made, check for:

1. Dirty filters, coils, or air intakes
2. Duct leakage
3. Filter leakage
4. Damper leakage, or blockage
5. Equipment vibrations
6. Correct damper operation

C. Simulate a pressure drop across filters equal to that when 50% loaded with dust.

1. Check fan motor amps with clean filters and simulated loaded filters, and report.

D. Procedure:

1. Measure and report the following for all supply, return, exhaust, and outside air systems:

a. Individual air inlets and outlets.
b. Pitot traverses of main supply, return, exhaust and outside air ducts.
c. Rotating valve or velocity grid traverse of coils or filters.
d. Plot operating point on fan curve. Include compensation for effects of altitude and inlet vanes.

2. Above measurements shall be made with system in normal, full load condition.

a. Systems with economizers shall be measured at minimum outside air and 100% outside air.
b. Systems with 100% outside air capability or evaporative cooling sections shall be measured at maximum outside air.
c. VAV systems shall be measured at the zone level at maximum air condition, and at the main at the system diversity condition.

3. Make main duct traverses or coil/filter traverses and report operation at all other operating conditions (as applicable).

a. Economizer operation
b. Unoccupied mode
c. Smoke evacuation mode
d. Pre-cool mode
e. Fail over mode
f. Two-speed fans
g. All VAV terminals driven to maximum position

4. Set fan speed such that under no condition will the motor exceed the service factor rating when operating in any of the above possible modes.
5. Measure fan motor amps in each of the above possible operating modes (clean filters).

E. Adjust Air Systems to provided proper air pressure relationships as shown by relative air quantities or as indicated on the drawings.

F. Adjust distribution system for uniform space temperatures free from objectionable drafts and noise.

G. Exchange sheaves and belts as required to adjust the rpm of all fans so they handle specified air quantity.

H. Set minimum outside air quantities.

3.3 DOMESTIC WATER SYSTEM

A. Scope: Balance all domestic hot water and hot water re-circulation systems.

B. Before any adjustments are made:

1. Check temperature control device operation (mixing valves, external temperature control devices, etc.).
2. Check rotation of pumps.
3. Adjust pressure reducing valves.
4. Verify proper operation of ASME pressure and temperature relief valves.

C. Using flow meters, adjust the quantity of water circulated by each pump and the flow in each branch of the hot water re-circulation systems.

3.4 HYDRONIC SYSTEMS

A. Scope: Balance all hydronic systems.

B. Before any adjustments are made:

1. Check temperature control valve operation.
2. Check pump rotation.
3. Adjust pressure reducing valve.
4. Remove any roughing strainer screens in systems.

C. Using system flow meters, adjust the quantity of fluid handled by each pump and supplied to each coil, piece of radiation, heat exchanger, cross-over bridge, bypass, etc., to meet design requirements.

D. Procedure:

1. Measure and report all hydronic and domestic water recirculation systems by all of the below means which are applicable.

    a. System, pump, branch, or terminal flow measuring stations.
    b. Terminal or heat exchanger pressure drop, compare to submittal data.
    c. Plot operating point on pump curve. Include compensation for effects of temperature, viscosity and density.

2. Above measurements to be made and reported at full heating/cooling load.

    a. For 3-way valve terminals/heat exchangers set bypass flow to equal coil flow.
    b. For primary/secondary systems, set crossover/bridle to have constant flow at all conditions.

3.5 DETAILED REQUIREMENTS

A. Measure, adjust and report the following:

1. Air Handling Unit Systems:

a. Total supply air CFM, fan speed, inlet pressure, outlet pressure, amp draw.
b. Total return air CFM, fan speed, inlet pressure, outlet pressure, amp draw.
c. Total relief/exhaust air CFM, fan speed, inlet pressure, outlet pressure, amp draw.
d. Outside air percentage at minimum and maximum setting.
e. Filter pressure drop.
f. Coil airflow.
g. Coil entering and leaving air temperature.
h. Coil entering and leaving air pressure.
i. Coil water flow.
j. Coil entering and leaving water temperature.
k. Coil entering and leaving water pressure.
l. kW draw on electric coils.
m. Space temperatures at thermostats or sensors.

2. Ductwork Systems:

a. Airflow at each inlet and outlet.
b. Airflow at supply, return, outside air, and exhaust mains to determine total airflow.
c. VAV box entering and leaving air temperature.
d. VAV box entering and leaving static pressure.
e. VAV box airflow at minimum position, maximum position, and heating position.
f. Fan-powered VAV box entering primary air temperature and static pressure.
g. Fan-powered VAV box primary airflow at minimum and maximum position.
h. Fan-powered VAV box leaving air temperature at full cooling and full heating.
i. Space temperature at thermostats or sensors.

3. Fan Coil Unit Systems:

a. Supply fan airflow, fan speed, total static pressure, and amp draw.
b. Coil entering and leaving air temperature.
c. Coil water flow.
d. Coil entering and leaving water temperature.
e. Coil entering and leaving water pressure.
f. kW draw on electric coils.
g. Space temperatures at thermostats or sensors.

4. Ventilation/Outside Air Fans:

a. Total fan CFM.
b. Fan speed.
c. Fan total static pressure.

5. Environmental Fans:

a. Total fan CFM.
b. Fan speed.
c. Fan total static pressure.

6. Coils:

    a. Coil airflow.
    b. Coil entering and leaving air temperature.
    c. Coil entering and leaving air pressure.
    d. Coil water flow.
    e. Coil entering and leaving water temperature.
    f. Coil entering and leaving water pressure.

7. Heat Exchangers:

    a. Cooler fluid entering temperature, leaving temperature, and fluid flow.
    b. Warmer fluid entering temperature, leaving temperature, and fluid flow.

8. Heat Pump Chillers:

    a. Cooling water flow.
    b. Cooling water temperature entering and leaving.
    c. Cooling water pressure entering and leaving.
    d. Heating water flow.
    e. Heating water temperature entering and leaving.
    f. Heating water pressure entering and leaving.
    g. Compressor safety and operating controls.
    h. Compressor amps and kW draw.
    i. Capacity reduction controls.
    j. Refrigerant suction pressure.
    k. Low ambient controls for packaged chiller systems.

9. Boilers:

    a. Heating water temperature entering and leaving.
    b. Heating water flow.
    c. Heating water pressure entering and leaving.
    d. Boiler safety and operating controls.
    e. Capacity reduction controls.
    f. Manufacturer’s start-up report may be substituted if all above measurements are included.

10. Pumps:

    a. Water flow.
    b. Entering and leaving water pressure.
    c. Motor amps and kW draw.
    d. Installed impeller diameter.

11. Split system air conditioners and heat pumps:

    a. Refrigerant suction pressure.
    b. Fan operation.
    c. Compressor operation.
    d. Low ambient controls.
    e. Automatic restart upon loss and regain of electrical power.

12. Controls:

    a. Operational setting of controllers and instruments.
    b. Positioning and function of valves and dampers.
    c. Interlock and operation of systems (HVAC and Fire).
    d. Gas pressure.

13. Cabinet Heaters and Unit Heaters:

    a. Entering and leaving air temperature.
    b. Entering and leaving water temperature.
    c. Water flow.
    d. kW draw on electric coils.
    e. Room air temperature.

3.6 REPORT

A. Provide a general information sheet listing:

1. Instruments used:

    a. Most recent calibration date.

2. Method of balancing.
3. Altitude correction.
4. Manufacturer’s performance data for all air devices used.

B. Provide data sheets for all equipment, including motors and drives, listing:

1. Make
2. Size
3. Serial number
4. Capacity Rating
5. Amperage
6. Voltage input
7. Thermal heater size for each motor
8. Operating speed of driver and driven devices
9. Any additional pertinent performance data

C. Include design and final values for all items listed in Detailed Requirements, and totals for each system.

D. Provide data sheets showing:

1. Air flow at each inlet and outlet
2. Instrument used
3. Velocity reading
4. Manufacturer’s free area factors

E. Provide recap sheet with explanation for each device not meeting specified performance.

F. Provide a set of prints with equipment, inlets and outlets marked to correspond to data sheets.

3.7 VERIFICATION

A. Upon completion of the TAB work the balancing firm shall demonstrate fluid flow quantities indicated in a preliminary TAB report.

1. The TAB representative shall be a member of the same team used during the original testing.
2. Equipment used during the random testing shall be the same equipment used during the original testing.
3. The system or equipment being verified shall be in the same operating mode as during the original TAB test.
4. Up to 10% of the air readings shall be re-tested. Ninety percent (90%) of the re-tested readings must be within tolerances of the specifications.
5. Up to 10% of the balanced heating hydronic component readings shall be re-tested. Ninety percent (90%) of the re-tested readings must be within tolerances of the specifications.
6. Up to 20% of the balanced chilled water component readings shall be re-tested. Ninety percent (90%) of the re-tested readings must be within tolerances of the specifications.
7. Whenever system verifications do not meet these specifications the entire system shall be re-balanced and rechecked.

3.8 COMMISSIONING

A. Reference Section 23 08 00 for commissioning scope.

B. Provide all necessary personnel, tools and equipment to comply with the commissioning scope.

END OF SECTION

SECTION 23 07 00 - MECHANICAL INSULATION

PART 1 - GENERAL

1.1 SUBMITTALS

A. Submit manufacturer's product data on the following:

1. Insulation.
2. Jackets, coatings and protective finishes.
3. Sealers, mastics and adhesives.
4. Fitting covers.
5. Manufacturer's installation details for fire rated duct wrap.
6. Low-Emitting Adhesives and Sealants EQc4.1 requirements for LEED submittals.

B. LEED:

1. In addition to meeting the general requirements for VOC emissions, detailed in the LEED Reference Guide, on-site wet-applied products must not contain excessive levels of VOCs, for the health of the installers and other trades workers who are exposed to these products. To demonstrate compliance, a product or layer must meet the following requirements, as applicable. Disclosure of VOC content must be made by the manufacturer. Any testing must follow the test method specified in the applicable regulation.

    a. All paints and coatings wet-applied on site must meet the applicable VOC limits of the California Air Resources Board (CARB) 2007, Suggested Control Measure (SCM) for Architectural Coatings, or the South Coast Air Quality Management District (SCAQMD) Rule 1113, effective June 3, 2011.
    b. All adhesives and sealants wet-applied on site must meet the applicable chemical content requirements of SCAQMD Rule 1168, July 1, 2005, Adhesive and Sealant Applications, as analyzed by the methods specified in Rule 1168. The provisions of SCAQMD Rule 1168 do not apply to adhesives and sealants subject to state or federal consumer product VOC regulations.

1.2 FLAME AND SMOKE RATINGS

A. Provide insulation tested on a composite basis (insulation, jacket, covering, sealer, mastic and adhesive) complying with the following:

1. Flame Spread: 25 or Less
2. Smoke Developed: 50 or Less
3. Method: ASTM E84 (NFPA 255)

1.3 PRODUCT DELIVERY

A. Deliver insulation products in factory containers bearing manufacturer's label showing fire hazard rating, density and thickness.

1.4 DEFINITIONS

A. Exposed Location: Located in mechanical rooms or other areas exposed to view.

B. Concealed Location: Located in pipe chases, furred spaces, attics, crawl-spaces, above suspended ceilings, or other locations not exposed to view.

1.5 STANDARDS

A. Comply with the latest edition of National Commercial and Industrial Insulation Standards.

B. Comply with the latest edition of the California Energy Commission Title 24 requirements.

PART 2 - PRODUCTS

2.1 PIPE INSULATION

A. Manufacturers:

1. 3M
2. Aeroflex
3. Armacell
4. ITW
5. Johns-Manville
6. K-Flex
7. Knauf
8. Manson Insulation
9. Owens-Corning
10. Unifrax

B. Materials:

1. Type FP - Fiberglass Pipe Insulation: Johns-Manville Micro-Lok heavy density pipe insulation with AP-T jacket.
2. Type FPF - Fiberglass Pipe Fitting Insulation: Johns-Manville “Zeston” fitting covers with factory-cut fiberglass insulation insert.
3. Type FCCP - Flexible Closed Cell Pipe Insulation: Armacell AP Armaflex, Aeroflex Aerocel, or K-Flex Insul-Tube. Compliant with ASTM E 84, NFPA 90A, and NFPA 90B.
4. Type FCCP-O – UV Resistant Flexible Closed Cell Pipe Insulation: Armacell UT Solaflex, Aerocel AC, K-Flex Insul-Tube with AL Clad System.
5. Type CGP - Cellular glass with vapor barrier coating: Owens Corning FOAMGLAS.
6. Type RCCP - Rigid Closed Cell Insulation (not for use indoors): ITW Trymer 2000XP, Dyplast ISO-C1/2.0, or GLT Products ISO-C1.
7. Type PFW - Plenum Fire Wrap: 3M Fire Barrier Plenum Wrap 5A+ or Unifrax FyreWrap 0.5 Plenum Insulation.

Materials indicated are provided as design basis. Equivalent insulation product by manufacturer indicated above is acceptable.

C. Insulation thickness and conductivity: (Thickness and conductivity listed below are minimum required. Provide thickness and conductivity required by Local Building or Energy Codes).

1. Service (Domestic) Water Piping:

a. Hot, 140ºF and under: (Insulation conductivity: 0.21–0.28 (Btu x in.)/(h x ft^2 x ºF))

1) Sizes smaller than 1-½": 1"
2) Sizes 1-½" and larger: 1-½"

b. Cold, 40ºF to 60ºF: (Insulation conductivity: 0.21–0.27 (Btu x in.)/(h x ft^2 x ºF))

1) Sizes smaller than 1-½": ½"
2) Sizes 1-½" and larger: 1"

2. Chilled Water:

a. 40ºF to 60ºF: (Insulation conductivity: 0.21–0.27 (Btu x in.)/(h x ft^2 x ºF))

1) Sizes smaller than 1-½": ½"
2) Sizes 1-½" and larger: 1"

b. 40ºF and under: (Insulation conductivity: 0.20–0.26 (Btu x in.)/(h x ft^2 x ºF))

1) Sizes smaller than 1": ½"
2) Sizes 1" and larger but smaller than 8": 1"
3) Sizes 8" and larger: 1-½"

3. Primary and Overflow Storm Water:

a. All Sizes: 1"

4. Refrigerant Suction Lines:

a. 40ºF to 60ºF: (Insulation conductivity: 0.21–0.27 (Btu x in.)/(h x ft^2 x ºF))

1) Sizes smaller than 1-½": ½"
2) Sizes 1-½" and larger: 1"

b. 40ºF and under: (Insulation conductivity: 0.20–0.26 (Btu x in.)/(h x ft^2 x ºF))

1) Sizes smaller than 1": ½"
2) Sizes 1" and larger but smaller than 8": 1"
3) Sizes 8" and larger: 1-½"

5. Refrigerant Liquid Lines:

a. All Sizes: ½" (1" for fiberglass)

6. All Heat Traced Piping: (Insulation conductivity: 0.27 or less (Btu x in.)/(h x ft^2 x ºF))

a. Refer to specification section 230503 Basic Mechanical Materials and Methods for insulation thickness.

7. Condensate Drain Piping:

a. All sizes: ½" (1" for fiberglass)

8. Acid Waste/Vent:

    a. All sizes: 1”

9. PVC pipe in plenums or above noise sensitive areas:

D. Application: Unless otherwise indicated, use the following:

1. Inside, above ground: Type FP fiberglass.
2. Inside exposed: Type FP fiberglass with PVC jacket (jacket not required in mechanical rooms).
3. Outside building envelope:

    a. Insulation thickness 1-1/2” and larger or line size 2-1/2” and larger: Type RCCP rigid closed cell with aluminum jacket.

        1) Provide sealant at all point joints to maintain vapor barrier.
        2) Sealant shall be per insulation manufacturer recommendation.
        3) Sealant submittal shall include a letter from the insulation manufacturer verifying that proposed sealant is compatible with insulation.

    b. Insulation thickness less than 1-1/2” and line size less than 2-1/2”: Type FCCP-O UV resistant flexible closed cell with aluminum jacket or flexible PVC insulation protector, Airex E-Flex or approved equal.

4. Refrigerant piping, inside, above ground: Type FCCP flexible closed cell insulation.
5. Refrigerant piping, outside building envelope: Type FCCP-O UV resistant flexible closed cell insulation.
6. Condensate drain piping: Type FCCP flexible closed cell or Type FP fiberglass insulation.

2.2 DUCT INSULATION

A. Manufacturers:

1. Aeroflex
2. Armacell
3. Certainteed
4. Johns Manville
5. K-Flex
6. Knauf
7. Owens-Corning

B. Materials:

1. Type FDL – Fiberglass Duct Liner: See Section 23 31 13, for duct liner requirements.
2. Type FCCL – Flexible Closed Cell Duct Liner: See Section 23 31 13, for duct liner requirements.
3. Type FDW - Flexible Faced Fiberglass Ductwork Insulation Wrap: Johns-Manville Microlite, with FSK factory applied foil-scrim-kraft facing. ASTM E 84 compliant.
4. Type RDB - Rigid Fiberglass Ductwork Insulation: Johns-Manville 800 Series, Spin-Glas Type 814, 3 lb. Density rigid board with FSK jacket.
5. Type RDB-O - Rigid Glass Mineral Wool Ductwork Insulation: Knauf Earthwool with all service jacket (ASJ).

6. Type FD - Flexible Plain Fiberglass Ductwork Insulation: Johns-Manville Microlite .75 lb/cu. Ft. unfaced.
7. Type FCCD - Flexible Closed Cell Duct Insulation: Armacell AP Armaflex, Aeroflex Aerocel, or K-Flex Insul-Sheet. ASTM E 84 compliant. Where located outside the building envelope, provide UV resistant paint.
8. Type CGD - Cellular Glass Ductwork Insulation: Owens Corning FOAMGLAS with vapor barrier.
9. Type ALJ - Outdoor Aluminum Jacket: 3M Venturclad 1579 GCW-WME with white finish, Polyguard Alumaguard Cool Wrap with white finish, or MFM Flex Clad 400 with white finish.
10. Ductwork Insulation Accessories: Provide staples, bands, wires, tape, anchors, corner angles, and similar accessories as recommended by the insulation manufacturer for the applications indicated.

Materials indicated are provided as design basis. Equivalent insulation or jacketing product by manufacturer indicated above is acceptable.

C. Application:

SYSTEM	EXPOSED	CONCEALED	OUTDOOR
Supply (Note 7,9)	1 ½" Type FDL duct liner	1 ½" Type FDL duct liner where noted, otherwise 1 ½" Type FDW duct wrap	1 ½" Type FDL internal liner + 1 ½" Type RDB-O external rigid + Type ALJ jacket (Note 4)
Return (Note 8,9)	1 ½" Type FDL duct liner	1 ½" Type FDL duct liner where noted, otherwise 1 ½" Type FDW duct wrap	1 ½" Type FDL internal liner + 1 ½" Type RDB-O external rigid + Type ALJ jacket (Note 4)
Exhaust (Note 9)	None (Note 6)	None (Note 6)	1" Type RDB-O external rigid + Type ALJ jacket (Note 4)
Outside Air	1" Type RDB external rigid	1 ½" Type FDW duct wrap	2" Type RDB-O external rigid + Type ALJ jacket (Note 4)

1. Reference 23 07 00/ Duct Insulation and 23 31 13/ Duct Liner.
2. Where energy codes require additional insulation over that listed above, provide insulation in accordance with those codes.
3. Insulate all accessories and components (fire dampers, silencers, air valves, etc.) of the duct systems noted above as requiring insulation. Where lined systems contain components that cannot be lined or have not been provided with liner, insulate them. That insulation shall overlap the lined portion of the system by at least 12 inches.
4. Build up and pitch insulation to prevent water ponding on rectangular ductwork 36" or greater in width.
5. Round ducts concealed above ceilings and serving individual terminal units or diffusers may be wrapped in lieu of liner.
6. Provide insulation of exhaust louver plenums and exhaust ductwork for first 20' from perimeter louvers or from perimeter louver to motorized damper or gravity damper. Provide Type FDL duct liner for exposed exhaust louver plenums and ductwork. Provide Type FDW duct wrap for concealed exhaust louver plenums and ductwork.
7. The following sections of the supply air systems shall be lined in lieu of wrapped:

    a. Provide duct liner 10 feet downstream of all balancing dampers. Duct wrap acceptable beyond 10 feet.

b. The discharge duct downstream of the VAV boxes shall be internally lined for 10 feet.
c. AHU R-01 and R-02 supply ductwork shall be internally lined from their connection to the AHU until they reach the vertical shaft. The main supply duct on levels 3, 4, and 5 that connect to the shaft shall be lined until they reduce in size. The main supply ducts on the basement level and level 1 and 2 shall be lined for 25 feet from the connection to the shaft.
d. AHU R-03, R-04, and R-05 supply ductwork shall be internally lined from the AHU to the shaft, a distance of approximately 50 feet.
e. AHU R-06 supply ductwork shall be internally lined from the connection to the AHU until the ducts reach the main loops and then for the next 30 feet in each loop.

8. The following sections of the supply air systems shall be lined in lieu of wrapped:

a. All return air ductwork 10 feet downstream of ceiling diffuser required to be lined.
b. AHU R-01 and R-02 return ductwork shall be internally lined from their connection to the AHU until they reach the vertical shaft. The main supply duct on levels 3, 4, and 5 that connect to the shaft shall be lined until they reduce in size. The main supply ducts on the basement level and level 1 and 2 shall be lined for 25 feet from the connection to the shaft.
c. AHU R-03, R-04, and R-05 return ductwork shall be internally lined from the AHU to the shaft, a distance of approximately 50 feet.
d. AHU R-06 return ductwork shall be internally lined from the connection to the AHU until the ducts reach the main loops and then for the next 30 feet in each loop.

9. All ductwork 35 feet downstream and upstream of fan shall be lined. Duct wrap acceptable beyond 35 feet.

2.3 EQUIPMENT INSULATION

A. Manufacturers:

1. Aeroflex
2. Armacell
3. Certainteed
4. Johns Manville
5. K-Flex
6. Knauf
7. Manson Insulation
8. Owens-Corning

B. Materials:

1. Type FE – Fiberglass Pipe and Tank Insulation: Johns-Manville Micro-Flex Large-diameter Pipe and Tank Fiberglass Insulation. Insulation shall be designed to conform to curved surfaces while maintaining insulation thickness and high compressive strength.
2. Type FCCE - Flexible Closed Cell Insulation: Armacell AP Armaflex, Aeroflex Aerocel, or K-Flex Insul-Sheet, sheet form. ASTM E 84 compliant.
3. Jacketing Material: PVC roll jacketing. Seal all joints.
4. Equipment Insulation Accessories: Provide staples, bands, wire, wire netting, tape, corner angles, anchors, stud pins, metal covers, adhesives, cements, sealers, mastics and protective finishes as recommended by insulation manufacturer for applications indicated.

C. Application:

1. Thickness: Refer to Part 3.
2. Inside, above ground: Type FE pipe and tank insulation.
3. Inside, exposed: Type FE pipe and tank insulation with PVC jacket (jacket not required in mechanical rooms).
4. Outside building envelope: Type FCCE flexible closed cell with UV resistant painted finish, white in color unless otherwise noted. Paint shall be by same manufacturer as insulation.

    a. Provide sealant at all point joints to maintain vapor barrier.
    b. Sealant shall be per insulation manufacturer recommendation.

PART 3 - EXECUTION

3.1 GENERAL

A. Verify acceptability of all materials which are to be used in air plenums (above ceiling, etc.). Materials must meet all requirements of Local Building Code and Authority having jurisdiction.

3.2 PIPE INSULATION

A. Insulate the following:

1. Domestic hot water piping.
2. Domestic cold water piping above ground and under slab.
3. Heating piping.
4. Chilled water piping.
5. Roof drain bodies and all horizontal primary and overflow storm water piping.
6. Refrigerant liquid, and suction lines.
7. Condensate drain piping.
8. Drain lines and traps serving ice makers/bins.
9. Heat traced piping.
10. Storm and sanitary piping where subject to freezing conditions.

B. Installation:

1. Install insulation on pipe system subsequent to testing and acceptance of tests.
2. Install insulation materials with smooth and even surfaces.

    a. Insulate each continuous run of piping with full length units of insulation, with a single cut piece to complete the run.
    b. Do not use cut pieces or scraps abutting each other.

3. Clean and dry pipe surfaces prior to insulating.

    a. Butt insulation joints firmly together to ensure a complete and tight fit over surfaces to be covered.

4. Extend piping insulation without interruption through pipe clamps, hangers, walls, floors and similar piping penetrations, except where otherwise indicated. Hangers and supports must be installed outside, not through, insulation.

5. Install protective metal shields and saddles where needed to prevent compression of insulation. Refer to Section 23 05 29.
6. Except as noted, cover valves, flanges, fittings and similar items in each piping system with equivalent thickness and composition of insulation as applied to adjoining pipe run.

    a. Install factory-molded, pre-cut or job-fabricated units (at Installer's option), except where a specific form or type is indicated.
    b. Do not cover:

        1) Valve operators.

    c. Provide removable access for:

        1) Strainers.
        2) Other components requiring access for service.

7. Mark location of unions and flanges covered by insulation with permanent paint or ink, or approved label.
8. Maintain integrity of vapor-barrier jackets on insulation of cold pipes and storm drainage piping, and protect to prevent puncture or other damage.
9. Insulate between pipe and pipe saddles. Provide suitable saddles.
10. Seal ends of sections with vapor barrier cement to crate moisture dams at:

    a. 21 ft. intervals.
    b. Valves and fittings.
    c. All hangers and supports.

11. Insulate new pipes and replace insulation on existing pipes to remain where insulation was removed or damaged by demolition or revisions.
12. Do not insulate basket access flange of flanged strainers.
13. Do not insulate steam traps.
14. Insulate between fingers of spiders in alignment guides.
15. Insulate between pipe and pipe slide.
16. Perform all work in a neat and workmanlike manner. Poor work (as determined by Architect or Engineer) will be cause for rejection.

3.3 OUTDOOR PIPE INSULATION

A. Install rigid insulation with butt joints of half pipe sections staggered. Insulation shall be held in place with strapping tape.

B. Install aluminum jacket with all joints lapped to shed water. Apply a bead of silicone sealant at all transverse and longitudinal seams. Secure with aluminum bands, minimum of 2 per jacket section. Contractor to verify that sealant has been applied per sealant and insulation manufacturer recommendations for proper vapor barrier.

C. Install flexible PVC insulation protector per manufacturer's installation requirements. Contractor to verify that insulation protector has been applied per insulation protector and insulation manufacturer recommendations for proper vapor barrier.

3.4 DUCTWORK INSULATION

A. Install insulation materials with smooth and even surfaces.

B. Clean and dry ductwork prior to insulating.

1. Butt insulation joints firmly together to ensure complete and tight fit over surfaces to be covered.

C. Extend ductwork insulation without interruption through walls, floors, and similar ductwork penetrations, except where otherwise indicated. Hangers and supports must be installed outside, not through, insulation.

D. Except as otherwise indicated, do not insulate lined ducts. However, extend duct insulation 12” beyond start of lining where lined ductwork meets insulated ductwork.

E. Maintain integrity of vapor-barrier on insulation of ducts carrying cold air, and protect it to prevent puncture and other damage.

F. Insulate backpans of all supply diffusers.

G. For Outdoor Insulation:

1. Stagger joints on multilayer applications.
2. Locate joints at sides of ducts whenever possible.
3. Utilize adhesive and vapor retarder as indicated by manufacturer for outdoor applications.
4. Use full coverage adhesive to adhere external insulation to ductwork. For flexible closed cell insulation, adhesive shall be by insulation manufacturer.
5. Vapor retarders shall overlap a minimum of 2” at all seams.
6. Cover flexible connections.
7. Extend covering to inside face of wall/roof.
8. Provide all exposed rigid insulation surfaces with protective aluminum jacket. Provide backing and aluminum jacketing tape at all sharp edges and fasteners. Do not puncture aluminum jacket.
9. Provide all outdoor flexible closed cell insulation with UV resistant painted finish, white in color unless otherwise noted. Paint shall be by same manufacturer as insulation.

3.5 EQUIPMENT INSULATION

A. Install insulation materials with smooth and even surfaces and on clean and dry surfaces.

1. Re-do poorly fitted joints.
2. Do not use mastic or joint sealer as filler for gaping joints and excessive voids resulting from poor workmanship.

B. Maintain integrity of vapor-barrier on equipment insulation and protect it to prevent puncture and other damage.

C. Apply insulation using the staggered joint method for both single and double layer construction, where feasible.

1. Apply each layer of insulation separately.

D. Do not insulate handholes, cleanouts, ASME stamp and manufacturer’s nameplate.

1. Provide neatly beveled edge at interruptions of insulation.

E. Chilled Water Pumps:

1. Do not insulate. Provide drain pan and drain to collect condensate formed on pump body. Pipe drain line to nearest floor drain and provide air gap.

F. Hot Equipment (Above Ambient Temperature):

1. Includes hot and heating water as well as steam equipment such as air release tanks, air separators, expansion tanks, flash tanks, vessels etc.
2. Insulate with 3" thick equipment insulation.
3. Do not apply insulation to equipment while hot.

G. Heat Exchanger:

1. Cover top and both sides of exchanger with 24-gauge galvanized steel panels with ½" Type FCCE flexible closed cell equipment insulation cemented to the inside of the panels.
2. Panels shall be easily removable and easy to re-install.
3. Adhere flexible closed cell insulation to end plates with Armacell Armaflex No. 520 adhesive or equivalent by selected insulation manufacturer.

H. Domestic Water Tanks:

1. Insulate domestic hot water tanks with 2 inches of equipment insulation or 1½ inches of rigid fiber glass board (if not originally insulated from the factory).

I. Cold Equipment (At or below ambient equipment):

1. Includes chilled, domestic cold, condenser water system equipment such as air release tanks, air separators, expansion tanks, flash tanks, vessels, etc.
2. Insulate air release tanks (air separators) with 2 inches of equipment insulation or 1½ inches of cellular glass insulation.

J. VAV Terminals:

1. Insulate heating water coil ends.

3.6 PROTECTION AND REPLACEMENT

A. Replace damaged insulation which cannot be repaired satisfactorily. Including units with vapor barrier damage and moisture saturation.

B. Protection: The insulation installer shall advise the Contractor of required protection for the insulation work during the remainder of the construction period, to avoid damage and deterioration.

END OF SECTION

SECTION 23 08 00 - BUILDING MECHANICAL SYSTEM COMMISSIONING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The requirements of the General Conditions, Supplemental Conditions and Section 23 05 02 apply to all work specified in this section.

B. Refer to Specification Section 23 05 93, title “Test and Balance” for interface requirements with test and balance contractor.

1.2 DESCRIPTION OF WORK

A. This specification covers the start-up, operating performance test and commissioning of the HVAC systems. The purpose of this effort is to bring the project mechanical systems to a state of dynamic operation in accordance with the contract documents by verifying the operation of individual components, subsystems and systems.

B. The Owner will retain the services of an independent commissioning agent (CxA) separate from the work of this Contract. As herein specified the Owner and CxA shall develop detailed commissioning procedures, equipment checkout procedures and data forms for recording compliance with contract documents, performance and punchlist deficiencies, and will assist in developing schedules for checkout and Owner acceptance, at a future date during the construction phase.

C. The Division 23 Mechanical Contractor and the General Contractor shall include as part of the work of this contract, labor and material to provide manpower, equipment, tools, ladders, instruments, etc. necessary to accomplish the work and labor and material for execution, monitoring and printing data forms necessary to verify and record system observations.

D. The Test and Balance Contractors shall include as part of the work of this contract, labor and material to provide manpower, equipment, tools, ladders, instruments, etc. necessary to execute and accomplish the work.

E. At the completion of the start-up, operations performance test and test and balance, the Contractor shall conduct a 72 hour dynamic mode demonstration of the systems in the presence of the Owner/Architect/Engineer and CxA.

1.3 COMMISSIONED EQUIPMENT

A. All Air Handlers as scheduled.

B. All VAV and FP boxes as scheduled.

C. All pumps as scheduled.

D. All fan coils as scheduled.

E. All split systems as scheduled.

F. All fans as scheduled.

G. Chillers.

H. Water Treatment.

I. Heat Exchanger.

1.4 COMMISSIONED SYSTEMS

A. All HVAC and Service Water Heating systems, as required by the 2018 International Energy Conservation Code.

PART 2 - PRODUCTS

2.1 MATERIALS, LABOR, INSTRUMENTS, TOOLS, LADDERS AND APPARATUS

A. The Contractor shall provide all materials, labor, instruments, tools, ladders and apparatus necessary to start-up, perform operating performance test and systems conditioning.

B. The Contractor shall be responsible for maintaining the commissioning documentation until final acceptance of the project. Final checklists will be produced by the CxA and provided prior to beginning commissioning. The commissioning documentation shall be kept current by the Contractor and shall be available for inspection at all times. At the time of acceptance of the project, the Contractor shall surrender 3 completed copies of the commissioning documentation to the Owner's representative.

PART 3 - EXECUTION

3.1 START-UP AND OPERATING PERFORMANCE TEST

A. Before request for contract compliance inspection and system commissioning all equipment, components, and systems shall be started-up, adjusted, calibrated; set, test and check all electric disconnect, fuses, circuit breakers, valves, dampers, temperatures and pressures of all systems for proper operation and performance. After completion of the start-up and operating performance test, the Contractor will notify the Owner in writing that the system is ready for commissioning.

B. Information, date, etc. from start-up and operating performance test may be utilized, as appropriate, to execute preliminary commissioning documentation, however, certification of equipment and systems for the preliminary commissioning phase shall be completed in accordance with paragraph 3.2 of this section of the specifications.

C. Start-up and operating performance test documentation shall include the following:

1. Air Handling Unit Systems:

a. Total supply air CFM, fan speed, inlet pressure, outlet pressure, amp draw.
b. Total return air CFM, fan speed, inlet pressure, outlet pressure, amp draw.
c. Total relief/exhaust air CFM, fan speed, inlet pressure, outlet pressure, amp draw.

d. Outside air percentage at minimum and maximum setting.
e. Filter pressure drop.
f. Coil airflow.
g. Coil entering and leaving air temperature.
h. Coil entering and leaving air pressure.
i. Coil water flow.
j. Coil entering and leaving water temperature.
k. Coil entering and leaving water pressure.
l. kW draw on electric coils.
m. Space temperatures at thermostats or sensors.

2. Ductwork Systems:

a. Airflow at each inlet and outlet.
b. Airflow at supply, return, outside air, and exhaust mains to determine total airflow.
c. VAV box entering and leaving air temperature.
d. VAV box entering and leaving static pressure.
e. VAV box airflow at minimum position, maximum position, and heating position.
f. Fan-powered VAV box entering primary air temperature and static pressure.
g. Fan-powered VAV box primary airflow at minimum and maximum position.
h. Fan-powered VAV box leaving air temperature at full cooling and full heating.
i. Space temperature at thermostats or sensors.

3. Fan Coil Unit Systems:

a. Supply fan airflow, fan speed, total static pressure, and amp draw.
b. Coil entering and leaving air temperature.
c. Coil water flow.
d. Coil entering and leaving water temperature.
e. Coil entering and leaving water pressure.
f. kW draw on electric coils.
g. Space temperatures at thermostats or sensors.

4. Ventilation/Outside Air Fans:

a. Total fan CFM.
b. Fan speed.
c. Fan total static pressure.

5. Environmental Fans:

a. Total fan CFM.
b. Fan speed.
c. Fan total static pressure.

6. Coils:

a. Coil airflow.
b. Coil entering and leaving air temperature.
c. Coil entering and leaving air pressure.
d. Coil water flow.
e. Coil entering and leaving water temperature.
f. Coil entering and leaving water pressure.

7. Heat Exchangers:

    a. Cooler fluid entering temperature, leaving temperature, and fluid flow.
    b. Warmer fluid entering temperature, leaving temperature, and fluid flow.

8. Chillers:

    a. Cooling water flow.
    b. Cooling water temperature entering and leaving.
    c. Cooling water pressure entering and leaving.
    d. Heating water flow.
    e. Heating water temperature entering and leaving.
    f. Heating water pressure entering and leaving.
    g. Compressor safety and operating controls.
    h. Compressor amps and kW draw.
    i. Capacity reduction controls.
    j. Refrigerant suction pressure.
    k. Low ambient controls for packaged chiller systems.

9. Pumps:

    a. Water flow.
    b. Entering and leaving water pressure.
    c. Motor amps and kW draw.
    d. Installed impeller diameter.

10. Split system air conditioners and heat pumps:

    a. Refrigerant suction pressure.
    b. Fan operation.
    c. Compressor operation.
    d. Low ambient controls.
    e. Automatic restart upon loss and regain of electrical power.

11. Controls:

    a. Operational setting of controllers and instruments.
    b. Positioning and function of valves and dampers.
    c. Interlock and operation of systems (HVAC and Fire).

12. Cabinet Heaters and Unit Heaters:

    a. Entering and leaving air temperature.
    b. Entering and leaving water temperature.
    c. Water flow.
    d. kW draw on electric coils.
    e. Room air temperature.

3.2 SYSTEM COMMISSIONING

A. All systems, components, equipment, etc. furnished as part of this Contract shall be subjected to system commissioning as hereinafter specified. All systems, components, equipment, etc. commissioned in this section of the Specifications shall be evaluated based on the sequences of control/operation, performance characteristics, and equipment schedules, etc. as specified in other sections of the Specifications and as shown on the contract drawings. Systems, components, equipment, etc. that does not have specified operating sequence, etc. shall be operated and evaluated based on its use and function for this project.

B. Commissioning Documentation: The Contractor shall maintain the commissioning documentation in 3-ring binders. The commissioning documentation shall be organized by system when practicable. All pages shall be numbered and a table of contents page shall be provided. The commissioning documentation shall include, but not be limited to, the following:

1. Design Criteria provided by the A/E.
2. Approved Test and Balance Report for the system or component being commissioned, provided by Test and Balance Contractor.
3. Approved submittals for all equipment to be commissioned, provided by Mechanical Contractor.
4. All approved shop drawings of equipment to be commissioned. Shop drawings shall be full size sheets folded as required to fit in binders. Provided by Mechanical Contractor.
5. All pre-commissioning checklists initialized by indicated personnel organized by system and subsystem.
6. All functional performance test checklist initialized by indicated personnel organized by systems and subsystems.
7. Three copies of the Operation and Maintenance Manuals specified in other sections of these specifications shall be reviewed by the CxA for completeness and for applicability. The manuals shall be incorporated in the Commissioning Documentation prior to the commencement of the training required in other sections of the specifications. Preparation of Operation and Maintenance Manuals shall be as specified in other sections of these specifications.

C. Shop Drawings and As-Built Drawings and Specifications shall be assembled by the Contractor after completion of the pre-commissioning phase and turned over to the Owner's representative. Changes as a result of subsequent Commissioning procedures will be incorporated (as required) at the conclusion of final Commissioning.

D. Commissioning Schedule:

1. Phase 1 - Preliminary Commissioning: All shop drawings, including but not limited to, equipment, controls, test and balance reports, and operation and maintenance manuals, shall be submitted and approved by the CxA. In addition, all pre-commissioning checklists shall be completed (initialed by all parties).
2. Phase 2 - Functional Performance Testing shall be performed as indicated on the Functional Performance Test Checklists. Functional Performance Testing shall not begin until Phase 1 of the commissioning process is complete. Owner's operation and maintenance personnel shall observe the function performance testing. The Contractor may perform initial system familiarization and training of Owner's operating and maintenance personnel required under other sections of the Specification during the functional performance testing.
3. Functional Performance Test Notification: The Contractor shall notify the CxA 2 weeks before functional performance testing is to begin.

4. Phase 3 - System training and operating instructions shall be conducted by the Contractor as indicated in the specifications of each item of equipment. The Contractor shall be responsible for specified training and operating instructions being observed by the CA.

E. Pre-Commissioning Checklists:

1. Pre-Commissioning Checklists shall be developed by the CxA and shall be executed and certified prior to the commencement of functional performance testing. The indicated initial is required in each location for all items, except where an “X” is shown indicating an initial is not required. See initials legend below for required initials. The pre-commissioning checklist will not be accepted as complete until all items have been initialed signifying this portion of the project is ready for Functional Performance Testing. The Contractor shall provide the CxA with the completed Pre-Commissioning Checklists for their review and initials. The CxA shall be the last person to initial each checklist item. The Contractor shall submit for approval a list of all contractor and subcontractor representatives responsible for the completion of the pre-commissioning checklist phase of the project. This list of representatives shall be submitted 2 weeks prior to commencement of any pre-commissioning activities of any systems or equipment. Representatives may be replaced only after written approval from the CxA.
2. Initials Legend:

    a. Construction Manager.
    b. Mechanical Contractor’s representative.
    c. Electrical Contractor’s representative.
    d. Commissioning Agent.
    e. Balancing Contractor’s representative.
    f. Controls Contractor’s representative.

3. Blank Example Pre-Commissioning Checklists are in Appendix, located at the end of this section of the specifications. A separate Pre-Commissioning checklist shall be provided for each system and piece of HVAC equipment to be Commissioned.

F. Functional Performance Test Checklist:

1. Functional performance testing shall be performed by the Contractor as directed by the CA and observed by a commissioning team consisting of the individuals indicated on the Functional Performance Test Checklists. The Contractor shall submit in writing a list of all contractor and subcontractor representatives responsible for the functional performance testing phase of the project. This list of representatives shall be submitted 2 weeks prior to the commencement of functional performance testing of systems and equipment. All representatives shall remain on the commissioning team throughout functional performance testing. Substitutions will not be permitted. Functional performance test checklists shall be completed in the presence of all commissioning team personnel at the time of the functional performance test.
2. Upon failure of completion of a functional performance test checklist, the Contractor shall provide a written report to the CxA listing the deficiencies causing the failure and remedies to correct all deficiencies. After the Contractor has corrected all deficiencies, the entire functional performance test checklist for the item of equipment shall be repeated. If possible, corrections can be accomplished during the functional performance testing of equipment in other non-related systems. In any case, no system will be accepted until all equipment items in the system have complete functional performance test checklists thereby demonstrating satisfactory performance.

3. Failure to complete 2 functional performance test checklists constitutes failure of Phase 2 of the HVAC Commissioning process. The Contractor shall provide a written report to the CxA listing the deficiencies causing all failures and remedies to correct all deficiencies. After correction of all deficiencies, Phase 2 of the HVAC Commissioning process shall be repeated in its entirety. The Contractor shall give the CxA 2 weeks notice before repeat functional performance testing is scheduled. Should the first or one subsequent functional performance test fail, the Owner reserves the right to obtain compensation from the Contractor for fees and expenses incurred in conjunction with having to perform more than two (2) functional performance tests.
4. Blank examples functional performance test checklists are in the Appendix 2 located at the end of this section of the specifications. A separate Functional Performance Checklist shall be provided for each system and piece of equipment to be Commissioned.

3.3 DEMONSTRATION TEST

A. After completion of system start-up, operating performance test and commissioning, but before Owner acceptance, the Contractor shall conduct a 72 hour dynamic mode demonstration of the systems provided under this Contract. The intent of the 72 hour dynamic test is to verify that the mechanical and electrical equipment will respond as designed to meet the changes that may occur under varying indoor/outdoor conditions including seasonal variations and occupancy loads.

B. A detailed procedure and sequence of events shall be developed by the Contractor and submitted to the Owner and CxA for review and approval. Procedures and sequence of events should contain as a minimum the following activities:

1. Hours 1-4: Bring all systems online for standard operations and parameters.
2. Hours 5-28: Operate all systems under normal parameters and verify proper operation.
3. Hours 29-52: Validation of systems operation through indoor/outdoor changes to include heating, cooling, ventilation, humidity control, domestic and control systems.
4. Hours 69-72: Return of systems to normal operation.

C. Systems and their associated equipment which are to be included in the dynamic test are all systems and components furnished under this Contract and as a minimum will include, but are not limited to the following:

1. Air Handling Systems
2. Chilled Water Systems
3. Domestic Water Systems
4. Fan Coil Systems
5. Pumping Systems
6. Exhaust Systems
7. Air Filtration Systems
8. Building Management and Control Systems

D. Contractor shall notify the Owner and CxA in writing that the project is completed and ready for the demonstration test. Schedule for test will then be established and documented. Initiation of the 72 hours dynamic test will not occur until all systems are balanced, operational and incorporated into the building management and control system. Should the demonstration test fail for any reason, the problems shall be corrected and another demonstration test conducted. Should the first or one subsequent demonstration test fail, the Owner reserves the right to obtain compensation from the Contractor for fees and expenses incurred in conjunction with having to witness more than two (2) 72 hour demonstration tests.

E. The attendees of each 72 hour demonstration test shall include representative from the following organizations:

1. General Contractor
2. Mechanical Contractor
3. Electrical Contractor
4. Test and Balance Contractor
5. Building Management and Control System Contractor
6. Architect of Record
7. Mechanical Engineer
8. Electrical Engineer
9. Commissioning Agent

Minor problems are anticipated and the necessary personnel required to correct problems and adjust systems need to be available to insure continuation of the dynamic testing process. If major problems are encountered, at the discretion of the Owner and CxA, the testing will be terminated and rescheduled.

The Contractor shall notify any external organizations, which would include but not be limited to DGS and Fire Department which are not directly involved in the testing, but might be affected due to interface to insure that alarms do not occur.

F. During the demonstration test all systems shall operate in the “hands-off” automatic mode in accordance with the requirements of the Contract Documents. Changes in operating modes required to simulate load shifting, seasonal changeover, emergency modes, etc. will be accomplished by changing set points and equipment operating status at the BMS central control console as required to observe capacity control and monitoring. Provide a readout of space temperature at each thermostat building relative humidity, building pressurization, chilled water supply and return temperatures and chiller capacity.

END OF SECTION

SECTION 23 08 01 - COMMISSIONING AGENT REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Refer to section 23 08 00 for commissioning requirements and Division 1 for additional information.

1.2 DESCRIPTION OF THE WORK

A. This Section covers the Scope of Work for the Commissioning Agent (CxA) who will be hired by the Owner.

B. The Commissioning Agent shall oversee the commissioning of the HVAC systems as described in Section 23 08 00. The CxA shall prepare pre-functional and functional performance test checklists to be used by the Contractor. Prepare and publish a commissioning plan. Witness startup and operational tests of equipment and systems. Perform observations of the mechanical systems throughout construction and prepare the final commissioning document.

C. The CxA shall have authority to direct and schedule test. The CxA shall have no authority to direct changes to the systems, or provide design related review comments.

1.3 COMMISSIONING PLAN

A. The CxA shall prepare a plan listing the parties involved with their responsibility, scope, definitions, safety concerns, design criteria, attendance schedules, commissioning schedules, and commissioning manual requirements.

1.4 COMMISSIONING FORMS

A. Review 100% CD’s. Provide written summary of how each commissioned item of equipment, should operate include calculations verifying scheduled capacity.

B. The CxA shall develop forms similar to that in Section 23 08 00 for the Contractors use during the commissioning process. The forms shall become part of the final commissioning manual. Forms shall be provided for each piece of commissioned equipment and system. Any deviations from the design shall be noted and proved by the Owner prior to acceptance. Each form shall be signed by the Contractor, CxA and Owner prior to acceptance of a system or piece of equipment.

1.5 COMMISSIONED EQUIPMENT

A. All Air Handlers as scheduled.

B. All VAV and FP boxes as scheduled.

C. All pumps as scheduled.

D. All fan coils as scheduled.

E. All split systems as scheduled.

F. All fans as scheduled.

G. Chillers.

H. Water Treatment.

I. Heat Exchanger.

1.6 COMMISSIONED SYSTEMS

A. All HVAC and Service Water Heating systems, as required by the 2018 International Energy Efficiency Code.

1.7 PROJECT OBSERVATIONS

A. The CxA shall perform observations of the commissioned equipment and systems twice a month at a minimum and more as required to keep pace with construction. The CxA shall note progress and any deviations of the construction documents shall be brought to attention of the Contractor and Owner for resolution. The CxA will have no authority to direct changes or corrections to the system. Observation reports shall be published to the Owner, Architect and Contractor and shall be part of the final commissioning manual.

1.8 OPERATIONAL AND START-UP TESTS

A. The CxA shall witness start-up tests and collect documentation of the tests. The CxA shall notify the Architect and Contractor of any deviations from the contract documents. Any deviations shall be corrected or accepted by the Owner prior to acceptance.

B. After the Contractor has submitted in writing that the systems are completed, the CxA shall schedule and direct operational tests of the systems. These tests shall be as described in Section 23 09 00 and 23 08 00. The results shall be documented and made part of the commissioning manual. Any deviations from the design shall be brought to the attention of the Architect and Contractor. Any deviations shall be corrected or accepted by the Owner prior to acceptance.

1.9 COMMISSIONING MANUAL

A. The CxA shall prepare the final commissioning manual. The manual shall provide a complete history of the commissioning process and shall include:

1. Design and Energy Codes.
2. Commissioning Plan.
3. Completed Commissioning Forms.
4. Completed Observation Reports.
5. Completed Start-up Reports.

6. System Operational Tests.
7. Final sequence of operation to be achieved.
8. Summary of building operation as commissioned, noting deviations from design.
9. Design Criteria (extended from Design Documents by CxA).
10. Written summary of normal startup and operating procedures for each commissioned item of equipment.

The manual shall be a three ring binder with tabs for each section. Provide 5 copies.

PART 2 - PRODUCTS – NOT USED

PART 3 - EXECUTION – NOT USED

END OF SECTION

This page is intentionally left blank.

SECTION 23 09 00 - BUILDING AUTOMATION AND AUTOMATIC TEMPERATURE CONTROL SYSTEMS

PART 1 - GENERAL

1.1 DESCRIPTION

A. The work described under this division is for all labor, materials, and equipment required for the construction of the Building Management System (BMS or BAS/Automatic Temperature Control (ATC) system.

B. The system shall be complete in all respects, tested and ready for operation.

C. All materials, equipment and apparatus shall be new and of first-class quality.

D. Electrical Standards: Provide electrical products which have been tested, listed and labeled by Underwriters' Laboratories and comply with NEMA standards and the National Electric Code.

E. "Operator" is defined as the Owner's representative designated to operate the BMS/ATC system after Owner acceptance.

1.2 GENERAL INSTRUCTIONS

A. The BMS/ATC systems as specified herein shall be provided in their entirety by the BMS/ATC Contractor. The BMS/ATC Contractor shall base their Bid on the systems as specified.

B. The general provision of the contract (Division 1 and sections 23 05 01, 23 05 02, and 23 05 03) apply to work specified in this section.

C. PRELIMINARY SUBMITTAL: Prospective BMS/ATC Contractors shall submit for review by the Owner's authorized representatives a preliminary written description of their proposed BMS/ATC systems, including block diagrams showing all major components and panels, printers and other processing devices and required cabling between each. Include environmental and space requirements for panels, CPU's and other major devices.

1. Include manufacturer's literature for each type of panel, controller or device that may be shown on the block Diagram.
2. Block Diagram shall show, schematically, the entire building system with all major components identified.
3. Include a points list for all input and output devices which shall be provided by the proposed systems.
4. Include information about proposed communications buss and data transmission.
5. Provide a written explanation of any characteristics, items of equipment or control intent, which differs from the requirements of this Division. Explain what, if any, alternative characteristics, items of equipment or control intent will be provided.
6. Alternate systems, characteristics, items of equipment or control intent, which do not comply with these specifications, may be rejected if not acceptable to the Engineer. Any rejected alternate system, characteristics, items of equipment or control intent shall be replaced by the specified system, characteristics, items of equipment or control intent at no extra cost to the project.

D. The successful Contractor shall provide a BMS system board or other hardware (if required) and the required software to Engineer so that internet connection may be made between the project and Engineer's office during the warranty period. The intent is to allow the Engineer lowest level Operator access during system installation, startup and demonstration.

1. This shall be made available to the engineer as soon as available. This Division is responsible for requesting IP address and coordinating software installation and access.

1.3 SCOPE

A. In general, the proposal shall be based on an electronic system. Valve and damper actuators are to be electronic – at BMS/ATC Contractor's option. Provide electronic sensors and transmitters with full DDC capabilities.

B. The engineering, installation, calibration, hardware, software programming and checkout necessary for complete and fully operational BMS/ATC systems, as specified hereafter, shall be provided under this division by the BMS/ATC Installer.

C. The BMS Contractor shall guarantee that the installed system is capable of maintaining the following comfort goals in conditioned areas served by the BMS.

1. Space Design Temperature +/- 1ºF.
2. Relative Humidity +/- 5%.
3. The BMS Contractor is not responsible for improper installation by other Divisions; however, the BMS Contractor is responsible for informing the Construction Manager and Engineer of any requirements of this specification or any installation problem which prevents these goals from being maintained.

D. The BMS contractor shall provide and install the Life Safety Control System as described in Section 23 09 02.

1.4 ITEMS REQUIRED TO BE COORDINATED WITH OTHER DIVISIONS

A. Contractor shall be responsible for coordinating the following:

1. Power requirements (voltage, amps, location) for all BMS equipment requiring power. See Section 23 05 01.

B. Installation and connection of all power wiring. Power wiring shall be defined as follows:

1. Wiring of power feeds through all disconnect starters and variable speed controllers to electric motors.
2. 120 VAC Emergency and 120V Normal power feeds to all BAS temperature control panels and equipment.
3. Wiring of any remote start/stop switches and manual or automatic motor speed control devices not furnished by the BAS/ATC Contractor.
4. See Division 23 05 01 for responsibilities.

C. Note that 120V to 24V surge protected transformers for low-voltage wiring by this Division shall be furnished, set in place and wired (from designated circuit in electrical panel) by this Division, and all low-voltage control wiring shall be installed under this Division.

1.5 WORK BY OTHERS

A. The following work shall be provided under separate divisions of the specifications:

1. Installation of all line size and non-line size automatic valves and separable wells. However, these devices shall be furnished under this division.
2. Provision of all necessary piping connections, taps and direct-contact wells required for flow, pressure or temperature devices specified under other divisions.
3. Provision of manual balancing dampers as specified under other divisions of Divisions 21 through 23.
4. Installation of all automatic control dampers shall be under Division 3 31 13. However, all control dampers shall be furnished under this division.

1.6 AGENCY LISTINGS

A. UL 916 PAZX Energy Management Systems.

B. FCC-Part 15 Subparagraph J. Class A. Emissions requirements.

C. UL-864/UUKL Smoke Removal.

1.7 RELATED SECTIONS

A. 23 05 01 - Mechanical and Electrical Coordination.

B. 23 05 02 - Basic Mechanical Requirements.

C. 23 05 03 - Basic Mechanical Materials and Methods.

1.8 BMS/ATC CONTRACTOR

A. The BMS/ATC Contractor shall have a local office within a 50-mile radius of the job site, staffed with factory trained engineers fully capable of providing instruction, routine maintenance and 24-hour emergency maintenance service on all system components. The BMS/ATC Contractor shall have a ten-year experience record in the design and installation of computerized building systems similar in scope and performance to that specified herein, and shall be prepared to provide evidence of this history prior to Contract Award should the Owner request it.

B. The BMS/ATC Contractor shall be prepared to make a personal presentation of their systems to the Owner or their designated representatives prior to award of Contract should the Owner request it.

C. The engineering, installation, calibration, hardware, software programming and checkout necessary for complete and fully operational BMS/ACT systems, shall be provided under this division by the BMS/ATC Installer.

D. Control components shall be mounted and wired by the BAS/ACT Contractor except as noted. Controllers may be mounted on terminal units at the factory.

1.9 SUBMITTALS AFTER CONTRACT AWARD

A. The following data/information shall be submitted for approval:

1. Complete sequence of operation.
2. Control system Cad generated drawings including all pertinent data to provide a functional operating system.
3. Valve, and damper schedules showing size, configuration, capacity and location of all equipment.
4. Data sheets for all hardware and software control components.
5. A description of the installation materials including conduit, wire, flex, etc.
6. Building Management System panel locations.
7. Network riser diagram.
8. Power riser diagram.

B. The Controls Contractor shall provide submitted drawings for the entire control system for review and approval before work shall begin. Included in the submittal drawings shall be a diagram depicting the system architecture complete with a communications riser. Drawings shall include point-to-point wiring diagrams and must show all temperature controls, start-stop arrangement for each piece of equipment, equipment interlocks, wiring terminal numbers and any special connection information required for properly controlling the mechanical equipment. The submittal shall include a bill of material reference list as well as equipment sequences of operation.

C. The submittals shall include a specification compliance analysis for review and approval before work shall begin. The compliance document shall address each paragraph of this specification by indicating COMPLY, EXCEED, or EXCEPTION. Do not indicate COMPLY unless the proposed system exactly meets the paragraph requirement. If EXCEED or EXCEPTION is indicated, then provide a clear and concise explanation of the variance from the specifications and the net effect this would have on the specified system performance.

D. Wiring diagrams shall include internal wiring of all electrical control devices.

E. Submit completed computer graphics for all the equipment and building floor plans minimum floors prior to scheduled completion of the project for approval.

PART 2 - PRODUCTS

2.1 GENERAL

A. The Building Management System (BMS) shall provide an easy to use interface for monitoring and managing the building. The Building Management System shall provide the necessary Hardware, Software, and Network Communication abilities to provide Scheduling, Monitoring, Trending, Historical Storage, and Alarm Functions for the HVAC equipment and systems as described in this specification. Control capabilities shall include: Time of Day scheduling, Direct Digital Control, Custom Control, Boolean Logic, Optimum Start/Stop, Duty Cycling, Electrical Demand Control, Temperature Control, After Hours Override, Reports and Logs, Trend Prints, Remote Communications, Alarm Logging, Run Time and Maintenance, and Expanded Informational Messages.

B. The BMS shall utilize either BACnet open protocol.

C. The BMS shall be fully accessible via secure internet connection. All required software and/or access to be provided to Engineer for use in troubleshooting.

D. The Building Management system shall be designed to allow full Operator operation with a minimum of training. It shall have an on-screen “Help” Operator tutorial.

E. Specified application programs shall be engineered, programmed and pre-tested prior to site installation. This shall be verified by standard format programming worksheets or flow diagrams included with the submittals.

2.2 BUILDING MANAGEMENT SYSTEM

A. Each panel memory shall be protected for a minimum of 48 hours in the event of power failure. Internal clock shall continue to run during a power failure so that the system makes the appropriate adjustment to all connected points when power is restored.

B. When specified or indicated on the point list or where required by the sequence of operation, outputs shall have three position manual override switch (On/Off/Auto), a status light, and shall be selectable for either normally open or closed operation.

2.3 MANUFACTURERS

A. Acceptable Manufacturers Are:

1. Alerton as installed by local factory authorized office
2. Andover/EcoStruxure by local factory authorized office
3. Carrier as installed by local factory authorized office
4. Delta Controls as installed by local factory authorized office
5. Distech Controls as installed by local factory authorized office
6. Johnson Controls as installed by local factory authorized office
7. KMC as installed by local factory authorized office
8. Reliable Controls as installed by local factory authorized office
9. Schneider Electric as installed by local factory authorized office
10. Siemens as installed by local factory authorized office.
11. Trane as installed by local factory authorized office.
12. Tridium as installed by local factory authorized office

Any other manufacturer shall be considered a substitution and may submit for approval after the bid.

2.4 OPERATOR INTERFACE

A. Local Interface. Furnish one PC based workstation(s). Each of these graphics based workstation(s) shall be able to access all information in the system. These workstation(s) shall reside on the same high-speed LAN as the building controllers. Each workstation shall be able to be custom configured based on the needs of the operator.

B. Hardware. Each operator workstation and custom programming workstation shall consist of the following:

1. Personal Computer. The CPU shall be a minimum of an Intel Core-i7 and operate at a minimum of 2.8 GHz. A minimum of 4 GB of RAM with expansion to 8 GB, DVD drive, Windows Professional or Enterprise 64-bit Operating System, a minimum 256 GB SSD shall be provided. A three-button mouse and keyboard will also be provided. Furnish all required USB and LAN communication ports or wireless capability for proper system operation. The PC shall have a minimum of a 27” flat panel monitor.
2. Provide a UPS battery backup comparable to an APC 550 VA desktop backup.
3. Printers: Each workstation shall have one (1) printer connected from the network or dedicated office printer with USB cable.

C. Workstation Software

1. Multiple Users: The system shall accommodate simultaneous multiple user operation. Access to the system data should be limited only by operator password. Multiple users shall have access to all valid system data. An operator shall be able to log onto any workstation on the system and have access to all valid data.
2. Operating System: Furnish a concurrent multi-tasking operating system. The operating system shall also support the use of other common software applications that operate under Microsoft Windows Professional such as Microsoft Office.
3. System Graphics: The Operator Workstation software shall be graphically oriented. The system shall allow display of up to multiple graphic screens at once for comparison and monitoring of system status. Provide a method for the operator to easily move between graphic displays and change the size and location of graphic displays on the screen. The system graphics shall be able to be modified while online. An operator with the proper password level shall be able to add, delete, or change dynamic points on a graphic. Dynamic points shall include analog and binary values, dynamic text, static text, and animation files. Graphics shall have the ability to show animation by shifting image files based on the status of the point.

    a. Standard Graphics. Provide graphics for each major piece of equipment in the building. This includes but not limited to, each Chiller, Air Handler, VAV Terminal, Fan Coil, Boiler, and Cooling Tower. These standard graphics shall show all points as specified in the points list.
    b. Custom Graphics. The system shall have custom graphics provided for all air handling systems and hydronic systems. Graphics shall also include actual floor plans showing equipment, and sensors. Custom graphic files shall be created with the use of a PC Paint package furnished with the system. The PC Paint package shall be a graphically based system that uses the mouse to create and modify graphics that are saved in industry standard formats such as PCX, TIFF, and GEM. The PC Paint package shall also provide the capability of capturing or converting graphics from other programs such as Designer, or AutoCad.
    c. Graphics Library. Furnish a complete library of common HVAC equipment such as chillers, boilers, air handlers, terminals, fan coils, and unit ventilators. This library shall also include symbols for other equipment including fans, pumps, valves, piping, and ductwork. The library shall be furnished in a file format compatible with the PC Paint Program.
    d. Photo Quality Input. The system shall be able to accommodate high resolution digitized photographs. These shall be scanned in from photographs or 35 MM slides. The owner shall be able to edit the photo quality graphics using the furnished PC Paint Program.

4. Workstation Applications. The workstation shall serve as the primary area of the system for operator interface and off-line storage of system information. The workstation shall also serve as the bridge to other building systems. Provide the following applications at the workstation.

    a. Manual Database Save and Restore. A system operator with the proper password clearance shall be able to save the database from any system panel. The operator shall also be able to clear a panel database and manually initiate a download of a specified database to any panel in the system.
    b. System Configuration. The workstation software shall provide a simple to use graphical method of configuring the system. As elements are located on the site they shall be displayed on a graphical representation of the system. This shall be flexible to allow for future system changes or additions.
    c. Online Help. Provide a context sensitive, online help system to assist the operator in operation and editing of the system. Online help shall be available for all applications and shall provide the relevant data for that particular screen. Additional help information shall be available through the use of hypertext.
    d. Security. Each operator shall be required to log on to the system with a username and a password in order to view, edit, add, or delete data. System security shall be selectable for each operator. The system supervisor shall have the ability to set passwords and security levels for all other operators. Each operator password shall be able to restrict the functions accessible to viewing and/or changing each system application, editor, and object (i.e., Operator One can view and change all airside data but only view chiller plant data, operator two can only acknowledge alarms and not view or change system data etc.) Each operator shall automatically be logged off of the system if no keyboard or mouse activity is detected. This auto logoff time shall be set per operator password. All system security data shall be stored in an encrypted format in the building management panels.
    e. System Diagnostics. The system shall automatically monitor the operation of all workstations, printers, modems, LAN connections, building management panels and controllers. The failure of any device shall be annunciated to the operator.
    f. Trend Logs. Each object in the system shall automatically be trend logged. This trend shall be stored for a minimum of 24 hours. The operator shall be able to view this trend on demand.
    g. Event Log. The operator shall be able to view all systems alarms and change of states. Events shall be listed chronologically. An operator with the proper security level may acknowledge and clear alarms. All that have not been cleared by the operator shall be archived to the hard disk on the workstation.
    h. Point Status and Control. Provide a method for the operator to view, and edit if applicable, the status of any object and property in the system. These statuses shall be available by menu on graphics or through custom programs.
    i. Clock Synchronization. The real-time clocks in all building control panels and workstations shall be synchronized on command of an operator. The system shall also be able to automatically sequence all system clocks, daily from any operator designated device in the system. The system shall automatically adjust for daylight savings and standard time if applicable.

5. Alarm Processing. Any object in the system shall be configurable to alarm in and out of normal state. The operator shall be able to configure the alarm limits, states and reactions for each object in the system.

    a. Binary Alarms. Each binary object shall be set to alarm based on the operator specified state. Provide the capability to automatically and manually disable alarming.

b. Analog Alarms. Each analog object shall have both high and low alarm limits a well as high and low “early warning” limits. Provide separate sets of limits for both occupied and unoccupied (on/off) conditions. Alarming must be able to be automatically or manually disabled.
c. Alarm Reactions. The operator shall be able to determine what action if any is to be taken, by object, during an alarm. Actions shall include logging, printing, starting programs, displaying messages, providing audible annunciation or displaying specific system graphics. Each of these actions shall be configurable by workstation and time of day. The system shall provide multiple levels of alarm priority.

6. Workstation Applications Editors. Each PC workstation shall support editing of all system applications. Provide graphically based editors for each application at the PC workstation. The applications shall be downloaded and executed at one or more of the building management panels.

   a. Application Specific Controller. Provide a full-page editor for each application specific controller. This shall allow the operator to view and change the configuration, name, control parameters and set points for each device.
   b. Scheduling.

      1) A complete graphically based editor for the scheduling application shall be provided at each workstation. Provide an easy to use method of selecting the desired schedule and month.
      2) This shall consist of graphically represented daily schedules and holidays.
      3) Provide the capability for seasonal schedules that will be automatically executed during user defined periods. This shall enable the operator to have a group of equipment in discrete “Summer” and “Winter” schedules. Each seasonal schedule shall only be active during the operator specified time periods. The schedule shall be available for viewing and editing even when not active. The operator viewing a schedule shall be able to see graphically whether the schedule is active or inactive for up to a year in advance.
      4) An operator with proper password level shall be able to modify the schedule. Schedules shall be able to be easily copied between objects and/or dates.

7. Custom Programming Language. Provide the capability to perform custom applications. The custom programming editor shall be accessible from all workstations. The operator shall be able to create, edit, and download custom programs at the same time that all other system applications are operating. The system shall be fully operable while custom routines are edited, compiled, and downloaded. Systems that require the operator interface be shut down to edit and compile programs shall include and additional Custom Programming Workstation. This workstation shall be identical to the operator’s workstation in section 2.04.B.

   The Program editor shall allow for creation, editing, troubleshooting, and simulation of custom programs. The editor shall check for proper programming context, use, spelling, and format. The custom programming editor shall also compile the program and be able to upload and download to the building management panel. All custom routines shall be executed at the building management panel.

8. Alarm Annunciation.

    a. Upon the incidence of an alarm, an alarm window shall be displayed showing the point in alarm, the time and date of the alarm and a user-selected predefined alarm message (and optionally printed to a user defined printer, printers and/or VT-100 or dumb terminal devices). Alarms shall be displayed regardless of the application in use including any non-DDC system DOS or Windows applications. The program shall display the current unacknowledged and acknowledged alarms. The user shall be able to selectively enable or disable a reminder in the event there are unacknowledged alarms. This reminder shall be both visual and audible. The user shall be able to record their own reminder messages and select the frequency at which they will play.
    b. Acknowledgement of alarms shall be from the alarm “pop-up” and/or from a separate alarm summary. Acknowledgment shall be by a specific event, date range, class, or specific alarm definition and condition. Upon acknowledging the alarm, the name of the operator acknowledging the alarm and the time and date will be associated with the acknowledgement, this data will be stored to the alarm history file and printed to the chosen printers or terminal devices.
    c. The system shall allow automatic or manual display of associated dynamic graphic screens and trend charts shall be provided for each alarm.
    d. Upon exiting the alarm handling mode, the user shall be placed back to the application in use at the time of alarm/exception occurrence.
    e. A current alarm screen shall be provided which will dynamically display only alarms that are currently in alarm. As alarms are return-to-normal from their respective alarm states the current alarm screen shall be dynamically updated to reflect the change.

9. Trend Management

    a. The program shall automatically perform time based periodic collection of real time point data and subsequently store it to the systems hard disk. There shall be local and remote modes of operation. Local collection shall allow the program to directly query the controllers for individual point samples. Remote collection shall mean the controllers collect and store trend data on individual points and then release the entire trend table(s) upon a request from the computer workstation.
    b. Storage and manipulation of sample points shall only be limited by disk space. Sampling rates shall be user selectable from instantaneous (once a second or less) to once a week. Collection of data shall be user selectable to start and stop on specific times and dates.
    c. Charting of the trend data shall be an integral part of the trend management program. Third party graphing packages such as Excel shall not be required to implement this program. Multiple points shall be chartable. Multiple X/Y charts may be run simultaneously displaying either real time data (instantaneous) or historical. Y scaling shall be either automatic or user selectable for any chart displayed, each chart may have different scaling. X scales shall be user selectable allowing for display of data over the wide range of times and dates. Multiple years of data shall be allowed. The chart display shall be capable of displaying a window of time as short as 15 seconds. Average, high and low values shall be displayed for selected point.

10. Reporting

    a. The report section shall be the gateway to the database for all data collected and shall provide an easy means of reporting and information management.
    b. The report generator shall be an integral part of the system. Offline third-party packages (such as Excel) for report manipulation shall not be required to implement this program.
    c. Reports on historical trend data shall allow for daily, weekly, monthly and yearly reporting. These reports shall be completely flexible on the data items to be reported on. The user shall be able to select from a list of predefined reports or selected data items on-the-fly. The selection of data item shall not be restricted by panel source. Reports shall have multiple columns and be infinite in length. Reports must be capable of reporting on data that has been collected at varying time intervals. Report generator shall allow an operator to easily and quickly define the contents of a report as well as define a print time and date if so desired. Information contained in the reports shall be derived from alarm history, system database, trend data and timed overrides.
    d. The operator shall be able to compile reports by user, department, time and data period, point or points.

11. Multi-tasking

    a. The system shall be capable of true multi-tasking capabilities. The user shall be able to use other non-related programs in the system while still running all DDC system application with no interruptions. This shall include the use of real time data in other applications. This feature shall allow spread sheet programs to gather data from the system dynamically while running a dynamically updated graphic screen. The system shall have the ability to allow the passing of data freely to MS Windows application, which incorporate the use of Dynamic Data Exchange.

2.5 SYSTEM PERFORMANCE

A. The system shall consist of Operator Workstation, Building Management Panels, and Application Specific Controllers. All elements of the system shall be designed for standalone operation. Control shall always occur at the lowest level of the system. Communication between the building management panels and workstations shall be over a high-speed communications buss. All nodes on this LAN shall be peers. The operator shall not have to know the panel identifier or location to view or control an object. Application Specific Controllers shall be constantly scanned by the building management panels to update point information and alarm information.

2.6 SYSTEM APPLICATION CONTROLLER SOFTWARE

A. System Security: User access shall be secured using individual security passwords and usernames.

B. Passwords shall restrict the user to only the object, applications and system functions as assigned by the system manager.

2.7 SYSTEM SOFTWARE

A. Furnish the following applications for building and energy management. All software applications shall reside and run in the system controllers. Editing of applications shall occur at the operator workstation.

1. Scheduling: Provide the capability to schedule each object or group of objects in the system. Each scheduler shall consist of the following:

a. Weekly Schedule: Provide separate schedules for each day of the week. Each of these schedules should include the capability for start, stop, optimal start, optimal stop, and night economizer. Each scheduler may consist of up to 10 events. When a group of objects are scheduled together, provide the capability to adjust the start and stop times for each number.
b. Exception Schedules: Provide the ability for the operator to designate any day of the year as an exception schedule. Exception schedules may be defined up to one year in advance. Once an exception schedule is executed, it will be discarded and replaced by the standard schedule for that day of the week.
c. Holiday Schedules: Provide the capability for the operator to define up to 30 special or holiday schedules. These schedules may be placed on the scheduling calendar and will be repeated each year. The operator shall be able to define the length of each holiday period.

2. Optimal Start/Stop: The scheduling application outlined above shall support an optimal start/stop algorithm. This shall calculate the thermal characteristics of a zone and start the equipment prior to occupancy to achieve the desired space temperature at the specified occupancy time. Provide an early start limit in minutes to prevent the system from starting too early.
3. System Coordination: Provide a standard application for the proper coordination of equipment.
4. Alarm Reporting.
5. Trending.
6. Diagnostics.
7. Power Fail Recovery.
8. Reports and Logs.
9. Chiller Sequencing.

2.8 NETWORK CONTROLLERS

A. General. Provide an adequate number of Building Management Panels to provide the performance specified above. Each of these panels shall meet the following requirements.

1. The Building Automation System shall be composed of one or more independent stand-alone, microprocessor based Network Controllers to manage the global strategies describes in Application software section.
2. The Master Controller shall have substantial memory to support its operating system, database, and programming requirements.
3. The multi-tasking operating system of the Controller shall manage the input and output communications signals to allow distributed controllers to share real and virtual point information and allow central monitoring and alarms.
4. Data shall automatically be shared between Master Controllers when they are networked together.

5. The database and custom programming routines of remote Network Controllers shall be editable from a single operator station.
6. The Master Controller shall continually check the status of all processor and memory circuits. If a failure is detected, the controller shall:

    a. Assume a predetermined failure mode.
    b. Emit an alarm.
    c. Display card failure identification.

B. Communications. Each Master Controller and Operator Workstation shall communicate using 10/100/1000 Ethernet (IEEE802.3). This LAN shall be self configuring and shall automatically reconfigure as nodes are added or removed.

1. Hard Wired Connections. Provide a twisted pair copper (CAT.5E or higher) cable between all nodes on the system LAN. Provide all necessary network switches to complete the network.
2. Each master controller shall reside on an Echelon LonWorks/LonTalk protocol network with data transmission speeds of at least 1.25 MBPS.

C. Serviceability. The Network Controller should be designed in a modular fashion so that the enclosure may be roughed in prior to the installation of the electronics. Provide diagnostic LEDs for power, communications, and alarms. The controller shall have provisions for expansion and future controller architecture. All wiring connections shall be made to field serviceable terminal strips or to a termination card connected by a ribbon cable.

D. Memory. The Network Controller shall maintain all BIOS and programming information in EEPROM. The system BIOS shall be easily upgradable for the PC workstation without the need for going out to the panel. System manufacturer shall provide current version software and firmware at the end of the warranty period.

2.9 APPLICATION SPECIFIC CONTROLLERS

A. Application Specific Controllers shall be stand-alone, microprocessor based Direct Digital Controllers with sufficient EEPROM memory to handle its operating system, database and programming requirements.

B. The controllers shall be clearly labeled as to controller type, where it is to be installed, and software address (if applicable). The controller shall be fully tested upon installation to ensure that it is properly matched to the equipment it is controlling.

C. The controller shall communicate with other devices on the communication network and be fully integrated with the other system components.

D. The hardware shall be suitable for the anticipated ambient conditions.

1. Controllers used outdoors and/or in wet ambient shall be mounted within waterproof enclosures, and shall be rated for operation at –40°F to 155°F.
2. Controller used in conditioned ambient shall be mounted in dust-proof enclosures, and shall be rated for operation at 32°F to 120°F.

E. Box Controllers

1. The VAV terminal units shall be individually controlled by a dedicated DDC VAV controller. The DDC VAV controller, damper motor, transducer and transformer (if required) shall be supplied by the BAS contractor.

    a. To assure proper operation and control, the BAS contractor as part of this bid, shall recalibrate the transducers six (6) months after acceptance of the BMS system to correct any deviations as a result of transducer drift.
    b. Submit a copy of the recalibration report to the Engineer, Mechanical Contractor, Test, Adjust and Balance Contractor and Owner.

2. The BMS shall perform the following VAV Terminal unit control strategies and provide the points as listed on the DDC/VAV point list and specified monitoring and diagnostics.

    a. Grouping: The BAS shall be able to group VAV boxes via keyboard commands. These groups shall make it possible for the operator to send a common command to all boxes in a group to operate in the same mode. A sample of this group report must be provided in the submittal package for approval by Engineer and Owner. BAS shall also compile on a group basis, the following:

        1) Minimum group temperature.
        2) Maximum group temperature.
        3) Average group temperature.
        4) Current airflow through boxes in group (total).
        5) Total ventilation airflow in group (total).

    b. Setpoint Control: The BMS shall edit the zone space temperature setpoint of each VAV box. The zone temperature setpoint shall be operator adjustable. Individual zone setpoint and control logic shall reside at the zone level, and not be dependent upon the BMS for control. In the event of communication loss, the box will continue to control to current setpoints.
    c. Manual/Automatic Setpoint Control: Where indicated in the contract documents, provide a combination zone temperature sensor/thermostat (S/T) with master control via the Operator's Workstation. In automatic mode, the S/T shall operate only as a room sensor. In Manual mode, the space occupant shall have the capability to raise or lower space setpoint.
    d. Override Button: Where indicated on the contract documents, the VAV box shall be capable of being placed in the "occupied" mode. Operation of the over-ride shall energize the associated air handler.
    e. Override Cancel Button: The VAV box shall be capable of being placed back into the "occupied" mode by the zone occupant.

        1) The following areas shall have manual temperature re-set capability and unoccupied over-ride button:

            a) All office areas.
            b) All other areas shall have temperature sensing capability only.

    f. Cooling Valve Control: The BMS shall control the cooling air valve to a fully open, fully close, maximum CFM, or minimum CFM position based on operator commands. The operator shall also have the capability to adjust the maximum and minimum airflow limits of the air valve through the BMS.

g. Operating Mode: The BMS shall place the box in either the occupied or unoccupied mode based on an operator adjustable time schedule. Separate heating and cooling setpoints shall be enterable for each mode through the BMS. Other modes available for special applications shall include full open, full closed, maximum flow, heating flow, minimum flow.
h. Control Offset: The BMS shall be capable of offsetting the cooling or heating setpoints of one or more groups of boxes by an operator adjustable amount. This capacity will allow for automatic zone setpoint changes based on system requirements, such as demand limiting.
i. Automatic Recalibration: The system shall automatically recalibrate its air flow sensing and air valve position measurement system at system startup and on a schedule basis.
j. Portable interface terminal: The VAV box shall have a communications port on the space sensor for use with a handheld portable operator's terminal. This portable terminal shall give the operator the capability to interrogate and edit DDC/VAV box parameters. Portable interface terminal shall also have the capability to interrogate and edit DDC/VAV box parameters from a central controller.
k. Terminal Unit Status Reports: For each terminal unit, the BMS shall provide an operating status summary of all unit sensed values (zone temperature, CFM, etc.), setpoint and modes.
l. Terminal Unit Group Report: For each group of VAV terminal units, the BMS shall report the group mode, heating and cooling airflow, average zone temperature, minimum zone temperature, and maximum zone temperature. The report shall also display for each terminal unit in the group, the present temperature control setpoints and the current zone temperature.

3. Terminal Box Diagnostics:

a. If zone temperature sensor input fails above its high range, unit shall control at its maximum CFM setpoint. If sensor input fails below its low range, units shall control to its minimum CFM setpoint.
b. In both cases, all heat outputs shall be disabled. A diagnostic message shall be displayed upon operator inquiry.
c. If flow measuring system fails, unit shall automatically convert to a pressure dependent, damper position based algorithm. Diagnostic message shall be displayed upon operator inquiry.
d. If zone temperature setpoint potentiometer on zone sensor fails, unit shall automatically control to programmed occupied setpoints. Diagnostic message shall be displayed upon operator inquiry.
e. If communications are not lost, controller shall continue to operate in current mode of operation. All setpoints shall be retained in nonvolatile memory. If communications are not restored within 15 minutes, unit shall automatically initiate a reset-recalibrate.

2.10 CUSTOM APPLICATION CONTROLLERS

A. The Custom Application Controllers shall provide stand-alone control and require no additional system components for complete operation. It shall have sufficient EEPROM memory to support its operation system, database, and programming requirements. Custom application controllers shall meet the requirements of 2.06 Master Control Panels except they shall reside on a communications network operating at a minimum of 38,400 KBPS.

B. All programming required for operation shall be memory resident and shall be retained in permanent memory.

C. The Custom Application Controller shall be configured such that the Portable Operators Terminal can be plugged directly into it or within sight for programming, editing, and other operator functions. Custom application controllers shall also be programmable from the operator workstation.

D. Controller hardware shall be suitable for the anticipated ambient conditions.

E. Controllers used outdoors and/or in wet ambient shall be mounted within waterproof enclosures and shall be rated for operation at –40°F to 155°F.

F. Controller used in conditioned ambient shall be mounted in dust-proof enclosures, and shall be rated for operation at 32°F to 120°F.

2.11 INPUT/OUTPUT INTERFACE

A. Hardwired inputs and outputs may tie into the system through Master Control Panel, Custom Application, or Application Specific Controllers. Any critical points requiring immediate reaction shall be tied directly into the controller hosting the control software algorithm for the critical function.

B. Binary inputs shall allow the monitoring of on/off signals from remote devices. The binary inputs shall provide a sufficient wetting current to be compatible with commonly available control devices.

C. All status points shown on the point list shall be positive proof differential pressure or current sensing binary switches.

D. Analog inputs shall allow the monitoring of low-voltage, current, or resistance signals and shall have a minimum resolution of 0.1% of the sensing range. Analog inputs shall be compatible with, and field configurable to commonly available sensing devices.

E. Binary outputs shall provide a continuous low-voltage signal for on/off control of remote devices. Where specified in the sequence of operations or indicated on the points list, binary outputs shall have 3-position (on/off/auto) override switches, status lights, and shall be selectable for either normally open or normally closed position.

F. Analog outputs shall provide a modulating signal for the control of end devices. Outputs shall provide either a 0 to 10 VDC, 0 to 20 VDC or a 4 to 20 milliampere signal as required to provide proper control of the output device. Systems that utilize a pulse width modulating output (PWM) shall include a position feedback AI for each output.

G. System architecture shall allow for point expansion in one of the following ways:

1. The addition of input/output cards to an existing System Application Controller.
2. An additional panel and/or controller may be used to expand point capacity.
3. Ten (10) percent expansion capacity for all point typed in all DDC panels.

2.12 IDENTIFICATION

A. Engraved Labels

1. Material: Melamine plastic laminate.
2. Thickness: 1/16”.
3. Color

a. Surface: White.
b. Core: Black (letter color).

4. Fastenings: Any of the following:

a. Screws.
b. Rivets.
c. Permanent adhesive.

5. Lettering: Coordinate with shop drawings.

2.13 DUCT SMOKE DETECTORS

A. Duct smoke detectors shall be provided and wired in accordance with Section 23 05 01.

2.14 BMS/ATC CONTROL WIRING

A. General: 18 AWG Twisted pair cable shield wire shall be provided if required by system manufacturer.

B. Provide for all input and all analog output wiring.

C. Tinned copper conductors.

D. Do not run input/output wires together in the same conduit or wire bundle with 120V power wiring.

E. Refer to Part 3 below for locations where conduit is required. All rigid conduit shall comply with Division 26 requirements.

2.15 AUXILIARY CONTROL DEVICES

A. Dampers:

1. The Building Automation System supplier shall provide all automatic control dampers not specified to be supplied integral to the HVAC equipment.
2. Dampers shall be low leakage or high velocity low leakage air foil as specified in the sequence of operation or in the equipment specifications and schedules. All proportional dampers shall be opposed blade type, except mixing dampers shall be parallel type. Two position dampers may be opposed or parallel blade type.
3. Damper frames and blades shall be galvanized steel and a minimum of 16 gauge. Blade width shall not exceed 8 inches. Dampers and seals shall be suitable for temperature ranges of –50°F to 250ºF.

4. Blades: 14-gauge, or 16-gauge air foil shaped, double, galvanized steel or extruded aluminum.
5. Bearings: Nylon or oil impregnated.
6. Axles: Welded, hexagonal or pin lock, or with other approved method to prevent blade rotating on axle.
7. Hardware: Zinc plated steel or aluminum.
8. Standard Low Leakage Dampers:

    a. Standard low leakage dampers shall be provided to conserve energy. Dampers shall be equipped with neoprene edge seals and compressible metal jamb seals. Leakage shall not exceed 10 CFM/Sq. Ft. at 4" W.G. differential.
    b. Standard Low Leakage dampers shall be Ruskin, Model CD36 or equivalent.

9. High Velocity Low Leakage Dampers:

    a. Where specifically called out as "LOW LEAKAGE", provide the following:

        1) Field replaceable edge and end seals with be installed along the top, bottom, and side of the frame and each blade. Seals and bearings shall be suitable for temperature ranges from –40ºF to 200ºF. Leakage shall not exceed 6 CFM/Sq. Ft. at 4" W.G. differential.
        2) High Velocity Low Leakage dampers shall be Ruskin, Model CD60 or equivalent.

10. Provide low leakage dampers in the following locations:

    a. Outside air dampers.
    b. Motorized backdraft dampers.
    c. Motorized intake dampers.

2.16 CONTROL VALVES

A. Provide control valves of the type, body material and pressure class as determined by manufacturer, based on operating requirements and maximum pressure and temperature in the piping system.

B. Equip control valves with actuators of proper close-off rating.

C. Modulating control valves shall have equal percentage or linear flow characteristics.

D. Valve bodies shall be 2-way normally open or closed, or 3-way mixing as specified. Valve bodies 2" and smaller shall be bronze, screwed type and 2½" and larger shall be iron, flanged and rated at 240°F 125 psig except where otherwise noted.

E. Valves shall have stainless-steel stems and allow for servicing including packing, stem, and disk replacement, and offer a 5-year warranty on parts and labor.

F. Size valves for 50% coil pressure drop (minimum 3', maximum 12' pressure drop).

G. Two-position, two-way control valves shall have quick opening characteristics.

H. Three-way valves shown in mixing application shall have a single, double faced disk.

I. Three-way valves shown in diverting application shall have two separate disks on a common shaft.

2.17 VALVE ACTUATORS: (ELECTRIC)

A. Valve actuators shall be electronic low voltage (24VAC), and properly selected for the valve body and service. Belimo or equivalent.

B. Actuators shall be fully proportioning (if modulating) and be spring return for normally open or normally closed operation as called out in the sequence of operations.

C. Provide a handwheel or manual positioner mounted adjacent to valve to allow manual positioning of valve in the absence of power.

D. Tri-state floating control non-spring return actuators are acceptable for terminal reheat applications for sizes less than one inch.

E. Actuators that rely on heating a medium are not acceptable.

2.18 BUTTERFLY VALVES

Butterfly valves used for automatic control shall be lug type rated for 125 psi non-shock water service to 180°F.

A. Valve body shall be ductile iron with B-Nitrite (BUNA N) or EPDM molded seat and seals.

B. Disc material shall be cast bronze of aluminum-bronze with ASTM A-492 Type 416SS stainless-steel stem and fittings.

C. Valves shall be tight close off suitable for end of the line service.

D. Butterfly valves used for two position control shall be line size. Valves used for modulating control shall be sized for a minimum 5 psig differential pressure at full flow.

E. Three-way valve mixing or diverting configurations shall have factory provided linkage kits specifically manufactured for the piping arrangement and actuator used. Keystone or approved equivalent.

2.19 SPACE SENSORS (OCCUPANT INTERFACE)

A. Space sensors shall be equipped with setpoint adjustment and override switch. Space sensor shall have a portable service tool jack.

B. All space sensors shall include integral temperature sensor, humidity sensor and CO2 sensor. Space temperature shall be adjustable within adjustable range through central BMS. Humidity and CO2 shall be read to BMS for monitoring and control. Reference following sections for individual sensor requirements.

C. All space sensors located in restrooms, corridors, gymnasiums, cafeterias or similar use areas shall be provided with vented, protective and lockable plastic cover.

2.20 TEMPERATURE SENSORS

A. Temperature sensors shall be Resistance Temperature Detector (RTD) or Thermistor as dictated by the requirements of this specification.

B. Duct sensors shall be rigid or averaging as specified in the sequence of operations. Averaging sensors shall be a minimum of 5 feet in length.

C. Immersion sensors shall be provided with a separable stainless-steel or brass well to match pipe material.

D. Space sensors shall be equipped with setpoint adjustment and/or override switch as specified on the plans or in the sequence of operations. Space sensor shall have a portable service tool jack.

E. Accuracies shall be +/-1°F for standard applications. Where high accuracy is required, accuracies shall be +/- .2°F.

F. Duct-mounted averaging sensors shall utilize a sensing element incorporated in a copper capillary with a minimum length of 20 feet. The sensor shall be installed according to manufacturer's recommendation and looped and fastened at a minimum of every 36 inches.

G. Sunshields shall be provided for outside air sensors.

2.21 HUMIDITY SENSORS

A. Humidity sensors shall be capacitance or bulk polymer resistance type.

B. Duct and room sensors shall have a sensing range of 20 to 80% with accuracy of +/-3% R.H. Duct sensors shall be provided with a sampling chamber.

C. Outdoor air humidity sensors shall have a sensing range of 20 to 95% RH. They shall be suitable for ambient conditions of –40°F to 170°F.

2.22 DIFFERENTIAL PRESSURE AND CURRENT SWITCHES

A. Differential Pressure Switches shall be furnished as indicated for status purposes in air and water applications. Provide single pole double throw switch with fully adjustable differential pressure settings.

B. Sensing range shall be suitable for the application with accuracy of +/-2% of range and repeatability of +/-.5 % of range. Sensor shall be capable of withstanding up to 150% of rate pressure without damage.

C. Current switches shall be provided for status indications on variable air flow fans and variable pump speed applications. These switches shall be capable of installation and replacement without removing power wiring.

2.23 CARBON DIOXIDE (CO2) DETECTION SENSOR

A. Provide carbon dioxide gas detection sensors as indicated on drawings. Carbon dioxide detection sensors shall meet, at minimum, the following requirements:

1. Negligible temperature and humidity effect on accuracy.
2. 4-20 mA transducer interface with the BMS proportional to 0 to 2,000 ppm of carbon dioxide concentration.
3. 24 VAC or VDC @ 400 mA max voltage.
4. No maintenance or period sensor replacement needed.
5. Accuracy- 5% of reading or 100 ppm, whichever is greater.
6. Operating temperature of 32° F to 122° F.
7. Aspirating box.
8. Outside air sensor shall be environmentally protected.

B. If it meets the above requirements, provide Ventostat, Model T8100D (with display) or approved equal.

2.24 CARBON MONOXIDE (CO) DETECTION SENSOR

A. Provide carbon monoxide gas detection sensors as indicated on drawings. Carbon monoxide detection sensors shall meet, at minimum, the following requirements:

1. Negligible temperature and humidity effect on accuracy.
2. 4-20 mA transducer interface with the BMS proportional to 0 to 250 ppm of carbon monoxide concentration.
3. 24 VAC or VDC @ 400 mA max voltage.
4. No maintenance or period sensor replacement needed.
5. Accuracy 2% of reading or 5 ppm, whichever is greater.
6. Operating temperature of 32° F to 122° F.
7. Aspirating box.
8. Outside air sensor shall be environmentally protected.
9. Activate purge fan mode at 25 ppm. Activate full alarm mode at 200 ppm.

2.25 NITROGEN DIOXIDE (NO2) DETECTION SENSOR

A. Provide nitrogen dioxide gas detection sensors as indicated on drawings. Nitrogen dioxide detection sensors shall meet, at minimum, the following requirements:

1. Negligible temperature and humidity effect on accuracy.
2. 4-20 mA transducer interface with the BMS proportional to 0 to 10 ppm of nitrogen dioxide concentration.
3. 24 VAC or VDC @ 400 mA max voltage.
4. No maintenance or period sensor replacement needed.
5. Accuracy- 2% of reading or 2 ppm, whichever is greater.
6. Operating temperature of 32° F to 122° F.
7. Aspirating box.
8. Outside air sensor shall be environmentally protected.
9. Activate purge fan mode at 0.72 ppm. Activate full alarm mode at 2 ppm.

2.26 STATIC PRESSURE SENSORS

A. Static pressure sensors may be absolute or differential pressure type depending on installation requirements below.

B. For differential pressure type sensors, maximum poly tubing length shall not exceed 100'. Minimum poly tubing diameter shall be 3/8". Above 100' length, provide 2" PVC main with maximum 100' connection length to each indoor sensor or outdoor reference sensor. All PVC shall be located outside of return air plenums or provided with plenum rated insulation.

C. Absolute pressure type sensors shall measure absolute pressure at outdoor and indoor locations, with signal communicated and differential pressure calculated via the BMS.

D. The sensor range shall be closely matched to the system static pressure, - .5 to .5 inches, -1 to 1 inches, 0 to 2.5 inches.

E. Sensor accuracy shall be plus or minus 5% of the sensing range, and repeatability of 2% of sensor range.

F. All static pressure sensor tubing and piping must be pressure tested and any leaks sealed prior to operation.

PART 3 - EXECUTION

3.1 FUNCTION

A. Provide all components necessary to achieve the Sequences of Operation listed in Part IV and any additional industry standard functions normally required of a first class BMS/ATC installation.

B. This division shall provide a project manager who shall, as a part of their duties, be responsible for the following activities:

1. Coordination between this Contractor and all other trades, Owner, local authorities and the design team.
2. Scheduling of manpower, material delivery, equipment installation and checkout.
3. Maintenance of construction records such as project scheduling, manpower planning, and as-built drawings for project coordination and as-built drawings.

3.2 INSTALLATION METHODS

A. Install systems and materials in accordance with manufacturer's instructions, rough-in drawings and equipment details. Install electrical components and use electrical products complying with requirements of applicable Division 26 sections of these specifications.

B. The term "control wiring" is defined to include providing of wire, conduit, and miscellaneous materials as required for mounting and connecting electric or electronic control devises.

C. Control Wiring:

1. Number-code or color-code conductors appropriately for future identification and servicing of control system.
2. All line voltage power wiring required because of substitution of low-voltage power wiring equipment specified in this division, shall be provided by this division.
3. Comply with the applicable requirements of Division 26 for the installation of electrical wiring incidental to the temperature control system.
4. Comply with the applicable requirements of National Electrical Code and Standard Building Code for the installation of electrical wiring incidental to the temperature control system.
5. Control wiring shall be run in conduit where located within walls, above drywall ceilings, in other inaccessible areas, or in areas subject to damage (i.e., below 8’ in mechanical rooms). Conduit to meet requirements of Division 26. Wiring above lay-in acoustical ceilings may be run loose and not in conduit. Where not in rigid conduit, bundle wiring neatly and support with J-hooks form structure.
6. Conduit shall be run parallel to building lines properly supported and sized at a maximum of 40% fill. In no cases shall field installed conduit smaller than ½” trade size be allowed.
7. Where conductors are not in conduit (as allowed through an owner accepted substation request) cable rated for use in return air plenums shall be used in all locations.
8. BMS/ATC division shall provide all control transformers and all control wiring (including low-voltage actuator power wiring). This division shall also provide power wiring from the control circuits to the transformer locations and all other temperature control devices requiring power wiring. Division 26 shall furnish appropriate control circuits (both normal and emergency) in suitable panelboards located throughout the project.
9. BMS/ATC division shall provide UL listed surge protectors for all control circuits upstream of control transformers.

D. Equipment installed under other divisions of the specifications:

1. Furnish dampers, valves, thermostat wells, flow switches and other equipment to Installers at proper time.
2. Provide installation instructions.

E. Adjust low-leakage dampers so all gaskets and seals are properly compressed.

F. Provide outside air and relative humidity sensors at each outside air intake louvers for air handlers.

G. Install occupant controls (thermostats, etc.) at 48” A.F.F. or as directed by Architect.

3.3 IDENTIFICATION

A. Devices Inside Panels: Either of the following:

1. Engraved labels.
2. Lettered in permanent ink with felt tip marker.

B. Exposed Devices: Engraved labels.

C. Location: On the body of the device or on the surface to which it is mounted.

1. Do not put identification on removable covers.

D. Label each remotely-mounted control panel as to the device it controls.

3.4 OPERATING AMBIENT CONDITIONS

A. Electronic controls mounted in unconditioned space shall be rated for ambient operating conditions from -40°F to 155°F. Controls not meeting these limits shall be mounted in an accessible location within conditioned space.

B. Where controllers and other components are located in outdoor or unconditioned spaces provide cabinets with ventilation and/or electronic heaters where required to maintain temperature and moisture levels required for proper operation.

3.5 ACCESSIBILITY

A. Where enclosures for system components are located in an area that is subject to unauthorized access (i.e., parking garage, service corridor, storage room, etc.), provide lockable tamper-proof enclosure to prevent unauthorized access. Enclosure shall be ventilated as required for proper operation of components.

3.6 OWNER TRAINING

A. The BAS/ATC contractor shall provide 4 hard copies of an operator's manual describing all operating and routine maintenance service procedures to be used with the temperature control and Building Automation System supplied. This contractor shall instruct the owner's designated representatives in these procedures during the startup and test period. The owner training shall consist of a minimum of three (3) 8-hour instruction periods scheduled by the owner over the first 12 months of system operation. The training shall be scheduled during normal working hours.

B. Follow up training shall be provided under this Division for two (2) eight-hour instruction periods at six months and twelve months after building acceptance.

C. Provide minimum 40 classroom hours of factory training in programming and use of the BMS/ATC system for each of two people (designated by Owner). Provide room and board for trainee's class during this period if factory is located more than 30 miles from the project. Provide this training no more than six months, and no less than eighteen months after building acceptance.

3.7 CALIBRATION AND ADJUSTMENTS

A. After completion of the installation, perform final calibrations and adjustments of the equipment provided under this contract and supply services incidental to the proper performance of the ATC and BAS system under warranty below.

B. Provide operating software to Engineer for remote connection and troubleshooting.

3.8 OPERATION BY OWNER

A. Owner may require operation of part of the system prior to final acceptance. Operation is not to be construed as acceptance of work.

3.9 ACCEPTANCE PROCEDURE

A. General: The system installation shall be complete and tested for proper operation prior to acceptance testing for the Owner's authorized representative.

B. Upon completion of the calibration, Contractor shall startup the system and perform all necessary testing and run diagnostic tests to ensure proper operation. Installer shall be responsible for generating all software and entering all database necessary to perform the sequence of control and specified software routines. An acceptance test in the presence of the Owner's representative or Architect shall be performed.

1. If more than two of the first 10 devices tested, or more than 10% of the first 20 or more devices tested, fail to operate properly, the test shall be discontinued.
2. Additional testing, after corrections are made, shall be done at the Installer's expense.

C. A letter shall be submitted to the Architect requesting system acceptance. This letter shall certify all controls are installed and the software programs have been completely exercised for proper equipment operation. Acceptance testing will commence at a mutually agreeable time within ten (10) calendar days of request. When the field test procedures have been demonstrated to the Owner's representative, the system will be accepted. The warranty period will start at this time.

D. Field Equipment Test Procedures: DDC Zone and Local Controllers shall be demonstrated via a functional end-to-end test as follows:

1. All output channels shall be commanded (on/off, stop/start, adjust, etc.) and their operations verified.
2. All analog input channels shall be verified for proper operation.
3. All digital input channels shall be verified by changing the state of the field device and observing the appropriate change of displayed value.
4. If a point should fail testing, perform necessary repair action and retest failed point and all interlocked points.
5. Automatic control operation shall be verified by introducing an error into the system and observing the proper corrective system response.
6. Selected time and setpoint schedules shall be verified by changing the schedule and observing the correct response on the controlled outputs.

E. Workstation Test Procedures: The System Workstation test procedures shall be as follows:

1. Communication with each DDC Zone and Local Controller shall be demonstrated.
2. Operator commands will be explained and demonstrated.
3. Control sequences shall be demonstrated for proper operation.
4. All available system reports and logs shall be demonstrated at the System Workstation.
5. Correct system start-up and shutdown procedures shall be demonstrated.
6. All controllers shall be demonstrated to operate in standalone mode.

F. Acceptance Test of Mechanical Systems

1. Perform at least two (2) operational tests of the entire mechanical system as described in Section 01700 of the specifications.
2. Give each element of the system an operating test of not less than 48 hours' duration to demonstrate to the satisfaction of the Architect that the control system is functioning properly and that the system is capable of producing the required environmental conditions. During this test, operate the system entirely on automatic control and take periodic readings of the inside and outside wet and dry bulb temperatures. Obtain wet and dry bulb temperatures with a recording thermometer-hygrometer. Conduct tests with outside temperature and humidity conditions as near design conditions as practical.
3. Winter acceptance test shall be conducted when outside temperatures are at or near 20°F, summer acceptance test shall be conducted when outside temperatures are at or near 90°F db.
4. Conduct tests during summer and winter outdoor temperature extremes as specified above. Notify Owner seven (7) days in advance of proposed tests.
5. Record temperature and humidity at an exterior and interior location for each system as designated by the Engineer at least once every hour for 48 hours during tests.
6. Submit a report detailing the following:

    a. Instrument used:

        1) Most recent calibration date.

    b. Date of tests.
    c. Description of test apparatus locations and methods.
    d. Results of tests.
    e. Any abnormal usage of the building or abnormal system characteristics observed during the course of the test.

    See also performance test requirements on the Drawings.

3.10 RECORD DOCUMENTS

A. Electronic Media As-Built Documentation: After a successful acceptance demonstration, the Contractor shall submit as-built drawings of the completed project for final approval. After receiving final approval, supply complete 11X17 hard copy as-built drawing sets, together with diskettes to the owner. The number of hard copies shall be electronic media equal to the number of O&M manuals (Re: Division 1). Distribute via email.

B. Operation and Maintenance Manuals: Submit Operation and Maintenance manuals (Re: Division 1). Include the following in each manual:

1. BMS/ATC information for insertion into the Manufacturer's catalog data and specifications on all sensors, transmitters, controllers, control valves, damper actuators, gauges, indicators, terminals, and any miscellaneous components used in the system.
2. An Operator's Manual which will include detailed instructions for all operations of the system.
3. An Operator's Reference Table listing the addresses of all connected input points and output points. Settings shall be shown where applicable.
4. A Programmer's Manual which will include all information necessary to perform programming functions.
5. A language manual which will include a detailed description of the language used and all routines used by the system.

6. Flow charts of the control software programs utilized in the Temperature Control System.
7. Flow charts of the custom software programs utilized in the Temperature Control System.
8. Complete program listing file and parameter listing file for all programs.
9. A copy of the warranty.
10. Operating and maintenance cautions and instructions.
11. Recommended spare parts list.
12. Twelve (12) hour service phone number and point of contact.

3.11 WARRANTY

A. All BAS/ATC devices and installation shall be warranted to be free from defects in workmanship and material for a period of one year from the date of job acceptance by the owner. Any equipment, software, or labor found to be defective during this period shall be repaired or replaced without expense to the owner. Factory authorized warranty service shall be available within 50 miles of jobsite.

END OF SECTION

SECTION 23 09 02 - LIFE SAFETY SYSTEMS

PART 1 - GENERAL

1.1 SCOPE

A. The Section 23 09 00 contractor shall provide and install the system described in this section.

B. Smoke exhaust for the following areas:

1. Stair pressurization.
2. Elevator pressurization.
3. Atrium smoke exhaust.

C. Combination Fire/Smoke Detector Control.

D. Duct-Mounted Smoke Detector Control.

1.2 APPLICABLE CODES AND STANDARDS

A. NFPA 92A

B. NFPA 92B

C. NFPA 72

D. Local Code Requirements

E. Life Safety Report by Code Consultant

F. National Electric Code

G. UL 555 & 5555

H. UL 864/UUKL

1.3 RELATED SECTIONS

Section 23 34 00 – Fans

Section 23 33 00 – Ductwork Accessories

Section 23 09 00 – Building Automation and Automatic Temperature Control Systems.

Section 28 00 00 – Addressable Fire Alarm System

1.4 SUBMITTALS

PART 2 - PRODUCTS

2.1 CONTROL DEVICES

2.2 CONTROL PANELS

2.3 WIRING

2.4 DAMPERS

2.5 DUCT SMOKE DETECTORS

PART 3 - EXECUTION

3.1 FUNCTION

3.2 INSTALLATION METHODS

3.3 IDENTIFICATION

3.4 CALIBRATION AND ADJUSTMENTS

3.5 OWNER TRAINING

3.6 WARRANTY

END OF SECTION

SECTION 23 09 03 - SMOKE MANAGEMENT 23 09 03 AND 28 46 10

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplemental Conditions of the Construction Contract and Division 1 Specification Sections, apply to this Section.

1.2 SUBMITTALS

A. PRELIMINARY SUBMITTAL: Prospective smoke management contractors shall submit for review by the Owner's authorized representatives a preliminary written description of his proposed smoke management systems, including block diagrams showing all major components and panels and other processing devices and required cabling between each.

1. Include manufacturer's literature for each type of panel, controller or device that may be shown on the block Diagram.
2. Block Diagram shall show, schematically, the entire building system with all major components identified.
3. Include information about proposed communications buss and data transmission, including UL listings.
4. Provide a written explanation of any characteristics, items of equipment or control intent, which differs from the requirements of this Division. Explain what, if any, alternative characteristics, items of equipment or control intent will be provided.
5. Alternate systems, characteristics, items of equipment or control intent, which do not comply with these specifications, may be rejected if not acceptable to the Engineer. Any rejected alternate system, characteristics, items of equipment or control intent shall be replaced by the specified system, characteristics, items of equipment or control intent at no extra cost to the project.

B. The following data/information shall be submitted for approval:

1. FSCS and all associated components, including panel layout.
2. Complete sequence of operation including detailed matrix.
3. Smoke control dampers, including parallel BMS and smoke control interface requirements.
4. Air piping.
5. Communications wiring including survivability and supervisory requirements.
6. Smoke control system Cad generated drawings including all pertinent data to provide a functional operating system.
7. Smoke control damper schedules showing size, configuration, capacity and location of all equipment.
8. Data sheets for all hardware and software control components.
9. A description of the installation materials including conduit, wire, flex, etc.
10. Smoke control system panel locations.

C. The smoke management contractor shall provide submitted drawings for the entire control system for review and approval before work shall begin. Included in the submittal drawings shall be a diagram depicting the system architecture complete with a communications riser. Drawings shall include point-to-point wiring diagrams and must show all controls, start-stop arrangement for each piece of equipment, equipment interlocks, wiring terminal numbers and any special connection information required for properly controlling the mechanical equipment. The submittal shall include a bill of material reference list as well as equipment sequences of operation.

D. The submittals shall include a specification compliance analysis for review and approval before work shall begin. The compliance document shall address each paragraph of this specification by indicating COMPLY, EXCEED, or EXCEPTION. Do not indicate COMPLY unless the proposed system exactly meets the paragraph requirement. If EXCEED or EXCEPTION is indicated, then provide a clear and concise explanation of the variance from the specifications and the net effect this would have on the specified system performance.

E. Wiring diagrams shall include internal wiring of all electrical control devices.

F. Submit completed computer graphics for all the equipment and building floor plans showing respective smoke control zones prior to scheduled completion of the project for approval.

1.3 STANDARDS

A. Materials shall comply with the following standards.

1. NFPA 92 (2015 Edition)
2. NFPA 70 National Electrical Code
3. NFPA 72 National Fire Alarm Code
4. NFPA 101 Life Safety Code
5. Local Code Requirements and Amendments
6. Life Safety Report as prepared by Life Safety Report by Code Consultant
7. UL 555 Standard for Safety Fire Dampers
8. UL 555S Standard for Safety Leakage Rated Dampers for Use in Smoke Control Systems
9. UL 864/UUKL

1.4 RELATED WORK

A. Section 21 13 00 – Fire Suppression Sprinkler Systems

B. Section 23 34 00 – Fans

C. Section 23 33 00 – Ductwork Accessories

D. Section 23 09 00 – Building Automation and Automatic Temperature Control Systems.

E. Section 23 05 93 – Test Adjust and Balance

F. Section 28 46 00 – Addressable Fire Alarm System

PART 2 - PRODUCTS

2.1 DESCRIPTION OF SYSTEM(S)

A. Provide a fully functioning Smoke Management System. This system shall be fully coordinated with other life-safety within the building.

B. System shall include the use of both passive (architectural) and mechanical means to remove and prevent the movement of smoke. Mechanical methods include the following:

1. Stairwell pressurization**.**
2. Zoned smoke exhaust systems.

C. The intent of the Smoke Management System is to prevent the flow of smoke into egress areas of the building, and provide a tenable environment in the areas protected for a period of time sufficient to evacuate the building. It should be noted that smoke would exist in these areas.

D. All components of the Smoke Management System shall be able to operate during a fire event for not less than 20 minutes.

2.2 FIRE FIGHTERS' SMOKE CONTROL STATION (FSCS)

A. A Fire Fighters' Smoke Control Station (FSCS) shall be provided for full monitoring and manual override and control of all devices associated with the Smoke Management System. The FSCS and all control components shall be UUKL listed.

B. The FSCS shall have the highest priority of control over all other operational states, including automatic activation of the Smoke Management System. The FSCS shall bypass all other building automation functions and local "hard-wired" controls such as Hand-Off-Auto switches, high-limit status pressure switches, freeze stats and smoke detectors.

C. The FSCS shall not bypass controls intended to provide for electrical overloads, personal safety when servicing equipment or prevent system damage.

D. The FSCS shall not bypass duct-mounted smoke detectors on supply air systems that are not part of the Smoke Management System.

E. The FSCS shall include a graphic representation of the building, the smoke zones and the Smoke Management System. Fans, dampers, ductwork and other devices shall be clearly indicated on the FSCS along with direction of airflow.

F. The status of each component shall be indicated by a pilot light according to the following legend:

1.	GREEN	-	Devices in their ON or OPEN state.
2.	WHITE	-	Devices in their NORMAL or OPERATING state.
3.	YELLOW	-	Devices in their TROUBLE or FAULT state.
4.	RED	-	Devices in their OFF or CLOSED state.

G. The FSCS shall include switches for all devices associated with the Smoke Management System as follows:

1. ON-AUTO-OFF
   Control over each device that can be controlled from other locations or systems.

2. OPEN-AUTO-CLOSED
   Control over each damper that can be controlled from other locations or systems.

3. ON-OFF or OPEN-CLOSED
   Control over each device that is solely intended for use in the Smoke Management System.

H. When a switch is in the AUTO position, other automatic or manual devices shall be allowed to control the Smoke Management device, however once a control function is issued from the FSCS, no other system or device within the building shall countermand this action.

I. When a switch is in the AUTO position, the device's status shall be indicated (ON, OFF, OPEN, CLOSED) as noted above.

J. VAV terminal units that are all located within and serve only one Smoke Management zone may be controlled collectively.

K. A push-to test switch shall be provided to test all pilot lights.

L. The FSCS shall be labeled in plain English having a font equivalent to 12-point Helvetica bold.

M. A full-scale color drawing of the FSCS shall be submitted to the Engineer and the local Authority Having Jurisdiction for review and approval.

2.3 ACTIVATION

A. The Smoke Management System shall be automatically activated by a signal from any of the following devices within the appropriate smoke zone:

1. Sprinkler waterflow in zone.

   a. Sprinkler zones must match smoke zones

2. Fire department manual controls.
3. Beam detector.
4. Area smoke detectors.
5. Heat detectors.

B. The Smoke Management System shall also be manually activated and deactivated from the FSCS.

C. Response Times:

1. The Smoke Management System shall be activated immediately upon receipt of initiation signal (manual or automatic).

a. Devices within the system shall be activated and report the desired state or operational mode to the FSCS within the following timeline:

1)	Damper closing (start)	15 Seconds
2)	Damper opening (start)	15 Seconds
3)	Completion of damper travel	60 Seconds
4)	Fan energizing (start)	15 Seconds
5)	Fan de-energizing (start)	Immediately
6)	Fan volume modulation	30 Seconds
7)	Fan at desired state	75 Seconds
8)	Pressure control modulation	15 Seconds
9)	Temperature control override	Immediately
10)	Positive indication of status	15 Seconds

11) Total response time from detection to full equipment operation shall be no more than 110 seconds.

b. Response times indicated above shall be the same whether the system has been activated manually from the FSCS or automatically from any initiation device.
c. Components shall be sequenced as necessary to avoid physical damage to components and the system.

2.4 EQUIPMENT

A. All devices associated with the Smoke Management System shall be UL listed for their application.

B. Where applicable, all devices associated with the Smoke Management System shall be designed to withstand temperatures of 250 °F.

C. Dampers:

1. All dampers used in engineered Smoke Management Systems shall be UL listed in accordance with UL 555 Standard for Safety Fire Dampers and UL 555S Standard for Safety Leakage Rated Dampers for use in Smoke Control Systems.
2. Dampers shall be minimum Class II, rated for 250°F.

D. Fans:

1. Where applicable, fans shall be designed and certified by the manufacturer to withstand temperatures of 250 °F.
2. All fans used in conjunction with the Smoke Management System shall be equipped with 1.5 times (minimum of two) the number of belts required for operation.
3. Fan motors shall have a minimum service factor of 1.15.
4. Fans shall be supported in accordance with the building code, from non-combustible components.
5. Where fans are utilized for stair pressurization, they shall be enclosed in a 2-hour rated field assembled enclosure including (2) 12”x12” fire dampered openings for ventilation. All enclosure supports and associated power and control wiring shall be protected by a 2-hour rated system.

E. Ductwork: Ductwork shall be constructed and supported in accordance with the Mechanical Code. Ductwork shall be constructed to withstand temperatures of 250°F. Where shafts are used for pressurization or smoke evacuation, they shall be constructed to a minimum rating of +/- 25 lbs./sf or as indicated on structural documents.

F. Air Piping Used as Part of Smoke Control Systems: Hard copper tubing, Type L, wrought, copper or brass fittings installed per IBC Section 909.

2.5 ELECTRICAL POWER

A. All electrical installations shall comply with NFPA 70 National Electrical Code

B. All devices associated with the Smoke Management System requiring electrical power shall be provided with both normal and stand-by power. Transfer to stand-by power shall be automatic and occur within 10 seconds upon loss of normal power.

C. Devices associated with the Smoke Management System relying upon volatile memory shall be provided with an uninterruptible power source able to provide 15 minutes of power.

D. All power wiring shall be installed in conduit. In addition, power wiring serving smokeproof enclosure ventilation systems (such as stair or elevator pressurization systems) shall utilize a 2-hour rated cable or cable system.

E. Variable frequency drives serving smokeproof enclosure ventilation systems shall be provided with 2-hour rated enclosures with 24”x24” fire dampered opening when located indoors. All power wiring associated with such VFDs shall utilize a 2-hour rated cable or cable system per above.

2.6 CONTROLS

A. Wiring: In addition to meeting requirements of the electrical code, all wiring regardless of voltage, in conjunction with the Smoke Management System shall be installed in conduit.

B. Survivability: When wiring connecting the FSCS to any remote mounted controlling device exceeds 100 feet; the wire shall be installed within a 2-hour rated enclosure in addition to conduit. In addition, control wiring serving smokeproof enclosure ventilation systems (such as stair or elevator pressurization systems) shall utilize a 2-hour rated cable or cable system.

C. Supervision

1. Provide supervision of all components in association with the Smoke Management System. Supervision shall include positive confirmation of:

    a. Equipment operation (automatic activation, testing or manual over-ride).
    b. Presence of power down-stream of last point of disconnect for all dampers, fans and doors.
    c. Fans: Provide proof of airflow through the use of differential pressure sensors.
    d. Dampers and Makeup Air Doors: Provide proof of full open and full closed status through the use of end switches.

2. Supervision of devices shall be indicated at the FSCS.

PART 3 - EXECUTION

3.1 INDEPENDENT INSPECTOR

A. The Smoke Management System testing shall be carried out by an independent third-party Special Inspection Agency. Independent Inspector shall be a Consultant to the General Contractor.

B. The Special inspector shall be a licensed register mechanical engineer in the State of Maryland and shall be approved by the Authority Having Jurisdiction for the Smoke Management and Life Safety System.

3.2 TESTING

A. General: All components of the Smoke Management System shall be individually tested. Testing methodology shall include the following subsets:

1. Capacity test.(air volume and static pressure)
2. Functionality test.(equipment operates properly)
3. Sequence test.(equipment energizes as called for)

B. All devices shall be tested to demonstrate the correct operating sequence and output reporting under the following modes:

1. Normal power mode.
2. Stand-by power mode.
3. Manual over-ride.

C. Detection Devices:

1. All detection devices that are associated with the Smoke Management System shall be individually tested.
2. The Smoke Management System shall be tested by activating one representative detection device of each within a zone. For example, if a smoke zone is equipped with smoke detectors and water flow switches, only one smoke detector and one water flow switch need be activated within this zone.

D. Provide test report including the following data:

1. Date and time of tests.
2. Test participants, including local Code Authorities, representatives from the Design Team and the Construction Team.
3. Wind speed, wind direction and outside ambient air temperature.
4. Actual response times required for system operation.
5. Verification of correct operating sequences.
6. Fans:

    a. Examine fans for correct rotation.
    b. Record airflows.
    c. Reference Section 23 05 93 – Test Adjust and Balance for testing procedures.
    d. Provide manufacturer’s fan curve(s) and certification detailing compliance with exposure to elevated temperatures as noted above.

7. Ductwork (Including Shafts Utilized for Smoke Evacuation):

    a. All ductwork shall be leak tested to 1.5 times the maximum design pressure. Leakage shall not exceed 5% of design flow.
    b. Reference Section 23 05 93 – Test Adjust and Balance for testing procedures.

8. Inlets and outlets:

    a. Record airflow at all inlets and outlets.
    b. Reference Section 23 05 93 – Test Adjust and Balance for testing procedures.

9. Dampers: Each damper shall be tested to verify functionality.
10. Pressurization: Measure pressure differential between floors and between stairwell, vestibule and corridor(s). Measure door opening force at enclosed stairway doors.

3.3 SEQUENCE OF OPERATIONS

A. The Smoke Management System shall accomplish the following sequence reference plans of operation when activated:

END OF SECTION

SECTION 23 21 13 - HYDRONIC PIPING

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. This Section covers water piping carrying water at 200ºF or less, used in the following systems:

1. Heating system
2. Cooling system
3. Condensate drain system
4. Condenser water system

1.2 SUBMITTALS

A. Detailed piping shop drawings, which include sizes, layouts, and materials, must be properly submitted. Any piping installed without prior written approval by the engineer of record shall be replaced at the expense of the contractor.

B. Submit manufacturer's product data on the following:

1. Strainers
2. Expansion tanks
3. Air purgers
4. Air vents
5. Pressure reducing fill valves
6. Pressure temperature taps
7. Balancing valves
8. Thermometers
9. Flow indicating devices
10. Pot feeders
11. Automatic flow control valves
12. Relief valves
13. Glycol

PART 2 - PRODUCTS

2.1 PIPE AND FITTINGS

A. Size 2" and Smaller: Any of the following:

1. Steel pipe, Schedule 40 with 125-lb. cast iron threaded fittings (ASTM A-53).
2. Copper tube, hard temper, Type L with wrought copper fittings.

    a. Solder for copper tube joints:

        1) 30 psig to 175 psig: 95-5 tin antimony.
        2) Above 175 psig: Brazed joints.

b. Grooved Copper

B. Size 2½" and Larger: Steel pipe (ASTM A-53), standard schedule, with any of the following fittings:

1. Black steel standard weight butt weld.
2. 125-lb cast iron flanged.
3. Malleable or ductile iron grooved pipe fittings, designed for roll or cut grooved joint (grooved piping 24" and larger to be Schedule 40).

C. Snow Melt Piping:

1. All snowmelt tubing to be cross linked polyethylene with oxygen diffusion barrier. Tubing to meet ASTM F 76 and be rated for 180F at 100 psi.
2. Acceptable Manufacturers:

a. Kitec
b. Uponor
c. Viega
d. Watts
e. Wirsbo

3. Use pre-manufactured manifolds and fittings.
4. Use approved fittings for connections between dissimilar pipe systems. Provide brass couplings or bronze valves.

2.2 STRAINERS

A. Manufacturers:

1. Armstrong
2. Gruvlok
3. Hoffman
4. IMI Flow Design
5. Metraflex
6. Mueller
7. Sarco
8. Victaulic

B. Size 2" and Smaller: 250-lb cast iron, threaded.

C. Size 2½" and Larger: 125-lb cast iron, flanged or grooved.

D. Screens:

1. Final Screen:

a. Material: Type 304 stainless steel.
b. Perforations: 0.045" diameter, 233 holes per square inch.

2. Roughing Screen:

a. Material: Carbon steel.

3. Provide roughing screens at all circulation pumps and at any additional strainers upstream of primary plant equipment such as boilers, chillers, etc.

2.3 EXPANSION TANKS

A. Manufacturers:

1. Amtrol
2. Apollo
3. Armstrong
4. Flo Fab
5. ITT Bell & Gossett
6. John Wood
7. Taco
8. Wessels

B. Type: Bladder or Diaphragm

C. Design pre-charge pressure: Same as boiler make-up water PR fill valve.

D. Bladder or Diaphragm Material: EPDM, compatible with propylene glycol.

2.4 AIR PURGERS

A. Manufacturers:

1. Amtrol
2. Armstrong
3. Flo Fab
4. ITT Bell & Gossett
5. Spirotherm
6. Taco
7. Thrush

B. Model: ITT Bell & Gossett 107A

C. Float actuated, non-modulating, rated at 175 psig at 150 ºF and 150 psig at 250ºF.

2.5 AIR VENTS

A. Manufacturers:

1. Amtrol
2. Armstrong
3. Flo Fab
4. ITT Bell & Gossett
5. Spirotherm
6. Taco
7. Thrush

B. Resilient Parts: EPDM

C. Vents on Pipes Size 2” and Smaller: ITT Bell & Gossett Model 4V

D. Vents on Pipes Size 2½” and Larger: ITT Bell & Gossett Model 107A

E. Vents on Air Purgers: ITT Bell & Gossett Model 97

F. Automatic Air Vents: ITT Bell & Gossett Model 97

2.6 PRESSURE REDUCING FILL VALVES

A. Manufacturers:

1. Apollo
2. ITT Bell & Gossett
3. Taco
4. Thrush
5. Watts

B. Size: ¾”

C. Model:

1. 8 psig to 25 psig: ITT Bell & Gossett Model 7-12
2. 25 psig to 60 psig: ITT Bell & Gossett Model 7

2.7 PRESSURE TEMPERATURE TAPS

A. Manufacturers:

1. Omega
2. Petes Plug
3. Sisco
4. Trerice
5. Watts

B. Construction:

1. Body and Cap: Brass
2. Pressure: 500 psig
3. Temperature: 350ºF
4. Core: EPDM, self-sealing.
5. Cap: Gasketed, threaded.
6. Size: 1/4” NPT or 1/2” NPT.

C. Thermometer:

1. Number required: 1
2. Dial diameter: 2”
3. Range: 0º to 220º

D. Pressure Gauge Adapter:

1. Number required: 1

2. Model: GA-125

E. Pressure Gauge:

1. Number required: 1
2. Dial diameter: 4½”
3. Range: 0 to 100 psig
4. Accuracy: ½%

2.8 BALANCING VALVES

A. See Section 23 05 23.

2.9 THERMOMETERS

A. Manufacturers:

1. Dwyer
2. Ernst
3. Marsh
4. Trerice
5. Winters

B. Housing: 9” adjustable angle stem.

C. Tube: Lens front, red or blue liquid.

D. Range:

1. Chilled water, condenser water, 0ºF to 100ºF.
2. Hot water, 30ºF to 240ºF.

2.10 PRESSURE GAUGES

A. Manufacturers:

1. Dwyer
2. Ernst
3. Marsh
4. Trerice
5. Winters

B. Construction:

1. Liquid filled.
2. Minimum 3 1/2” diameter face with 270 degree arc.
3. Range: As required to keep normal operating point in mid 2/3 to 3/4 of dial.

a. Use 30” vacuum to 100 psi gauge for pumps designed to operate at pressures up to 75 psig total pressure. (Total pressure = required pump-off static pressure plus scheduled pump head).

4. Use higher pressure ranges as required such that scheduled total pressure does not exceed an operating point above ¾ range of dial.

C. Accuracy: 1% of full scale over middle of range.

2.11 POT FEEDERS

A. Manufacturers:

1. Griswold
2. J.L. Wingert
3. Neptune
4. Wessels

B. Construction: Minimum 200 psi at 200 degrees F.

C. Size: 2 gal.

2.12 AIR SEPARATORS

A. Manufacturers:

1. Amtrol
2. Armstrong
3. Flo Fab
4. ITT Bell & Gossett
5. John Wood
6. Spirotherm
7. Taco
8. Wessels

B. Constructed and nameplated for 125 psig working pressure and stamped in compliance with ASME boiler and pressure vessel code.

C. Provide blow-down connection.

D. Provide integral strainer.

2.13 RELIEF VALVES

A. Manufacturers:

1. Apollo
2. ITT Bell & Gossett
3. Kunkle
4. Spence
5. Taco
6. Thrush
7. Watts

B. Type: ASME

C. Size: Maximum input capacity of system at design pressure.

D. Setting: Operating pressure of system plus 2 psi unless otherwise noted.

2.14 AIR AND DIRT SEPARATORS

A. Manufacturers: Flo Fab, Spirotherm or preapproved equal.

B. Construction:

1. Steel shell.
2. Brass vent head.
3. Non-ferrous float.
4. Viton seal and O-ring.
5. Copper coalescing medium.
6. Brass ball valve.
7. Rated for 150 psig working pressure and 270F.

C. Options:

1. Provide removable lower head.

2.15 PROPYLENE GLYCOL

A. Manufacturers:

1. Dow Chemical Company
2. Dupont
3. Dynalene
4. Interstate Chemical Company, Inc.

B. Model: Dow Chemical Company Dowfrost

C. Type: Propylene Glycol with corrosion inhibitors. For glycol concentrations less than 30%, provide additional inhibitors per manufacturer’s recommendations for adequate corrosion and microbial growth protection. Added inhibitors must be compatible with the glycol and its inherent inhibitors.

2.16 REDUCED PRESSURE BACKFLOW PREVENTER

A. See Section 22 10 00.

2.17 VENTURI FLOW MEASUREMENT DEVICES

A. Manufacturers:

1. Gerand
2. Hyspan
3. Presso
4. Veris

B. Identification:

1. Provide engraved metal tag indicating Beta Ratio or flow curve.
2. Hang on chain to clear insulation.

C. Size:

1. Select Beta ratio to provide 10” to 30” water gauge meter reading.

2.18 COIL CONNECTION KITS

A. Manufacturers:

1. Hays.
2. IMI Flow Design.
3. Victaulic 78Y/78U.

B. Combination Y-Strainer, union, PT port, and ball valve

1. 400 psi maximum CWP, available as sweat x sweat; sweat x female threaded; female threaded x sweat; female threaded x female threaded; DZR brass body consisting of a full port ball valve and strainer with flow measuring ports.
2. Ball valve shall be complete with double 0-ring seal, plated ball, blow-out proof stem, and steel handle with vinyl grip. Strainer shall be Y-pattern, with 20 mesh stainless-steel screen and blow-down port. Strainer/ball combination shall provide a simplified hookup to protect the coil and modulating valve. To be suitable for operating temperatures up to 230'F.

C. Coil Hoses

1. 375 psi maximum CWP (varies by size), stainless-steel braided hose and a synthetic polymer core with stainless ferrules; available as male by female swivel and male by male swivel and in three lengths: 12", 24" or 36". Suitable for operating temperatures up to 230 degrees F.
2. Install hoses free of kinks and coordinated with other equipment/accessories.
3. Hoses shall be insulated to meet requirements of 23 07 00 (Mechanical Insulation).
4. Provide air vents at all high points in piping systems. If the rigid pipe connection to the hose is higher than the coil air vent, provide additional air vent at high point.

D. Combination Union Port fitting with PT Port and Manual Air Vent

1. 400 psi maximum CWP, available as sweat x male threaded; female threaded x male threaded; DZR brass body with manual air vent port and pressure/temperature port, with EPDM seals. Union port fitting shall provide a simplified terminal hookup for installation at coil outlets. Suitable for operating temperatures to 230°F.

PART 3 - EXECUTION

3.1 PIPE INSTALLATION

A. Install horizontal piping level (except drain piping and as otherwise noted) and parallel to building construction. All vertical piping to be plumb.

B. Make any changes in direction with fittings, do not kink or bend piping. Elbows are to be long radius type wherever possible.

C. Where pipes pass expansion joints or structural elements subject to movement, provide flexible expansion compensators and supports or piping expansion loops to allow for movement without adverse effects.

D. Regardless of how shown on schematic piping diagrams, do not install a tee so that flow enters from opposite directions.

E. Do not rearrange piping in a manner to increase pressure drop without written approval from Architect/Engineer.

F. Install drains at all low points of the system.

3.2 EQUIPMENT CONNECTIONS

A. Do not allow weight of piping or expansion of piping to put stress on equipment connections.

B. Pipe equipment to allow for servicing (coil pull, tube pull, etc.) with minimum of disruption to piping.

C. Provide unions or flanges at all equipment connections.

3.3 FREEZE PROTECTION

A. Fill systems with indicated solution by volume of propylene glycol and water.

B. Pre-mix all solutions before injection into system.

3.4 AIR VENTS

A. Install automatic air vents at high points in equipment rooms.

B. Install manual air vents at high points not in equipment rooms.

3.5 RELIEF VALVES

A. Install pressure relief valves on all vessels, which may be isolated from other relief valves by closing valves. Pipe discharge full size to nearest floor drain.

3.6 PRESSURE TEMPERATURE TAPS

A. In Pipes 2” and Smaller: Install taps in tee at change in direction so inserted thermometer stem will be parallel to center line of pipe.

1. Add extra change in direction if necessary.
2. Allow clearance for insertion of thermometer.
3. Insure that gauge or thermometer will be in a readable position.

3.7 HOT TAPS

A. Hot taps are to be used only after written permission by the Architect/Engineer. Submit intended procedure with request.

3.8 CLEANING

A. Flush the system thoroughly with clear water.

1. Drain system.
2. Clean all strainers.

B. Refill system with solution of 1 lb. trisodium phosphate to 50 gal of system water.

1. Heat system to design temperature.
2. Circulate as required to fully clean the piping system. Continuously check strainers and verify they have been clean for a minimum of two hours.
3. Stop circulation and drain system.
4. Clean all strainers.

C. Fill system with fresh water or water/glycol mixture.

3.9 CORROSION PROTECTION

A. Provide dielectric unions at unions between piping of different materials.

B. See Section 23 25 13 for water treatment program to be provided.

C. All components of system shall be compatible with propylene glycol and water solution.

3.10 PRESSURE GAUGES

A. Pump assemblies: Use a single gauge with multiple taps to pumped system (strainer inlet, strainer outlet, pump suction and pump discharge) per the detail on the drawings.

B. Allow clearance for removal of gauge.

C. Insure that gauge will be in a readable position.

END OF SECTION

SECTION 23 21 23 - HVAC PUMPS

PART 1 - GENERAL

1.1 MOTOR HORSEPOWER

A. Do not increase or decrease motor horsepower from that specified without written approval from Architect/Engineer. See Section 23 05 01.

B. Select pumps so that for single pump application at a minimum, brake horsepower does not exceed motor horsepower at rating point, and does not exceed motor horsepower plus service factor on impeller curve at 125% rated flow. For parallel pump application motor horsepower shall be selected such that pump can operate at any point on the pump curve without overloading.

1.2 PARALLEL PUMP SELECTION

A. Select pumps for parallel pump application such that a single pump can operate and not exceed the end operating point of the pump curve.

1.3 SUBMITTALS

A. Manufacturers Product Data: Submit manufacturer’s product data on pumps.

1. Include pump curve and mark rating point. Also include single pump operating point for a parallel pump application.
2. Show maximum allowable operating temperature and pressure.
3. Note in red any deviations from specified construction.
4. Show impeller diameter indicate maximum impeller diameter for pump volute provided, and indicate if impeller is machined down.

PART 2 - PRODUCTS

2.1 BASE-MOUNTED END SUCTION

A. Manufacturers:

1. Armstrong
2. Aurora
3. Bell & Gossett
4. Flo Fab
5. Mepco
6. Paco
7. Peerless
8. Taco

B. Design Conditions:

1. Pressure: 150 psig
2. Temperature: 225ºF

C. Construction:

1. Casing: Cast iron, with integral pedestal support.
2. Impeller: Bronze, statically and dynamically balanced.
3. Wear Ring: Bronze
4. Shaft: Steel with bronze sleeve or stainless steel.
5. Shaft Seal: Mechanical, carbon-ceramic, internally flushed
6. Base Plate: Steel or cast iron. Integral drip pan on chilled water and waterside economizer service.
7. Drive: Flexible couple.
8. Bearings: Grease lubricated ball bearings. Bearing housing supported from base plate.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General:

1. Install pumps to allow complete removal without dismantling connecting piping.
2. Provide air cock and drain connection on pump casing.
3. Decrease from line size with long radius reducing elbows or concentric reducers, or suction diffusers.
4. Support piping adjacent to pump so that no weight is carried on pump casings.
5. Comply with manufacturers recommendations for support of inline pumps. Provide support for motors when mounted horizontally. Verify Manufacturer’s allowable motor position and install accordingly.
6. Provide supports under elbows on pump suction and discharge line.
7. Provide one pressure gauge with piping and gauge cock to measure pressure of strainer inlet, pump suction, and pump discharge.
8. Manufacturer’s representative shall verify proper pump operation.

B. Level and Alignment – Base-Mounted Pumps:

1. Before any piping or electrical connections are made, level and align pumps and motors on bases and foundation pads using an indicating micrometer.
2. After connections have been made and just prior to placing each pump in operation, recheck levels and alignments.

    a. Make adjustments to assure that shaft rotates freely when turned by hand and that pump is quiet in operation.
    b. When adjustments are completed, tightly bolt and grout motor and pump.

C. Lubrication: After completion of the system and before start-up, lubricate the pumps.

D. Impeller Trim: Remove impeller and machine down if more than 25% of the total pump head must be throttled by the pump discharge valve.

E. For inline pumps with motors 7.5 HP and larger, provide a suitable lifting point (eye bolt, strut channel) directly over the motor to aid in removal of the rotating element.

F. Pipe drip pan base to floor drain.

G. Fully grout base-mounted pumps to housekeeping pads or inertia base per manufacturer's recommendations.

END OF SECTION

This page is intentionally left blank.

SECTION 23 23 00 - REFRIGERANT PIPING

PART 1 - GENERAL

1.1 QUALITY ASSURANCE

A. Installer: A firm with at least five years of successful installation experience on projects with refrigerant piping similar to that required for this project.

1.2 REGULATORY/REQUIREMENTS

A. Comply with applicable requirements of the Clean Air Act, State of Maryland and City and County Regulations concerning handling of refrigerants.

PART 2 - PRODUCTS

2.1 REFRIGERANT PIPING

A. Type ACR copper tube with wrought copper fittings.

B. End Caps:

1. Provide factory applied plastic end caps on each length of pipe and tube.
2. Maintain end caps through shipping, storage and handling as required to prevent pipe end damage and eliminate dirt and moisture from inside of pipe and tube.

2.2 SHUT-OFF VALVES

A. Manufacturers:

1. Design Basis: Henry
2. Other Acceptable Manufacturers:

    a. Imperial
    b. Mueller
    c. Superior

B. Size 7/8 Inch and Smaller:

1. Model: Series 600.
2. Type: Pack-less diaphragm.
3. Material: Forged bronze.
4. Flow: Non-directional.
5. Servicing: Diaphragm changeable under line pressure.

C. Size 1-1/8 Inch and Larger:

1. Model: Series 200.

2. Type: Wing cap, back seating.
3. Material: Bronze.

2.3 FLEXIBLE PIPE CONNECTORS

A. Manufacturers:

1. Design Basis: Mason
2. Other Acceptable Manufacturers:

    a. Flexonics
    b. Metraflex

B. Braided bronze with copper tube ends, compatible with refrigerant type for system

C. Flexible connector shall be line size or connection size, whichever is larger.

2.4 REFRIGERATION SPECIALTIES

A. Filter Drier:

1. Conform to ARI Standard 710.
2. Sizes ½" and larger - interchangeable core, full flow.
3. Sizes smaller than ½" - sealed type.
4. Minimum burst pressure - 1500 psig.

B. Sight Glass:

1. Double port moisture indicating, reversible color indicator.
2. Removable sight glass and moisture indicating element.
3. Furnish with a protective cover.

C. Expansion Valve:

1. Thermostatic type, diaphragm or bellows operated.
2. External superheat adjustment factory set for 10ºF superheat (adjustable).
3. Compatible with refrigerant type for the project.
4. Pressure rated per project requirements.
5. Power elements and valve size shall be as recommended by the manufacturer, for the service intended.

D. Solenoid Valve:

1. Provide solenoid valve for systems 25 tons and larger.
2. Compatible with refrigerant type for the project.
3. Valve shall fail in closed position (power open).

E. Acceptable Manufacturers:

1. Alco
2. Sporlen

PART 3 - EXECUTION

3.1 INSTALLATION

A. Run piping level or plumb, except slope gas piping to compressor with a minimum number of elbows.

B. Provide oil traps at bottom of suction risers. Size risers for proper oil return.

C. Size lines for total pressure drop not to exceed 2ºF saturation temperature.

D. Provide necessary flexibility for vibration and expansion with offsets and loops, not expansion joints.

E. Provide flexible connectors at all unit connections.

F. Replace air in pipe with dry nitrogen to prevent corrosion during soldering.

G. Install valves, sight glasses, filter-driers, and accessories, furnished by equipment supplier, but not factory installed.

H. Insulate all underground refrigerant lines with ½" flexible foam.

1. Use un-slit covering.
2. Carefully cement all joints.

3.2 HANGERS

A. For insulated piping, provide hangers of size to fit outside insulation.

B. For non-insulated piping, provide hangers with elastomer insert to prevent damage to piping from vibration.

3.3 TESTING AND DEHYDRATION

A. Use the following procedure to test and hydrate the systems:

1. Isolate any elements which would be damaged by test pressures.
2. Test system with trace gas using an appropriate leak detector.
3. Repair or replace leaking elements of system and re-test.
4. After system has been proven to be free of leaks, evacuate it with a high efficiency vacuum pump to 2.5 mm of mercury absolute.
5. Allow the system to stand under vacuum for 24 hours.

    a. Then, if a vacuum of 2.5 mm can be drawn within 30 minutes, the system shall be considered dry.
    b. If not, the procedure shall be repeated.

6. Break the final vacuum by charging with the correct refrigerant.

END OF SECTION

This page is intentionally left blank.

SECTION 23 25 13 - HVAC SYSTEM CHEMICAL TREATMENT

GENERAL

1.1 SCOPE

A. Furnish and install chemical treatment systems for closed hydronic systems where shown on the Drawings and as specified in this section.

B. Work under this section shall include providing equipment, chemicals, and service related to alter treatment for the chilled and heating water systems.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. Section 23 05 21 Pipe and Pipe Fittings.

B. Section 23 21 13 Hydronic Piping.

1.3 QUALITY ASSURANCE

A. The chemical treatment program shall be administered by a firm regularly engaged in the field of water treatment with a minimum of five years of experience in the immediate area of the job site location, and similar sized projects.

B. The water treatment contractor shall have laboratory facilities, both central and field, to service the Owner’s account.

C. The water treatment contractor shall have local warehousing and will not be allowed to overstock chemical on premises.

D. A single water treatment company shall be responsible for all products and services.

E. Comply with the requirements of the following agencies:

1. The applicable water quality control district.
2. The local sanitation district or sewage agency.
3. Applicable industrial waste regulations.
4. The California State Water Resources Board.
5. Conform to OSHA Standards for the handling and storage of hazardous chemicals.

1.4 SUBMITTALS

A. Provide product data for each piece of equipment installed the system and for each chemical used.

B. Provide shop drawings for control panel, including internal and external wiring diagrams, dimensions, etc.

C. Provide operation and maintenance manuals for all equipment.

D. Material Data Safety Sheets shall accompany all chemicals delivered to the job site.

PRODUCTS

2.1 PRE-STARTUP CLEANER

A. Furnish pre-startup liquid detergent dispersant cleaner for flushing and cleaning of water systems to remove oil and foreign matter from piping and equipment prior to final filling of systems. Chemical shall not be injurious to persons, piping, pipe joint compounds, packings, coils, valves, pumps, and their mechanical seals, tubes, or other parts of the system.

B. Furnish complete instructions dictating quantities of cleaner to use, method of cleaning, duration or operation.

2.2 CHEMICALS

A. A buffered Molybdate and/or Nitrite based corrosion inhibitor shall be provided to initially treat the closed systems and added as required for 1 year from date of owner acceptance. This treatment must contain a copper inhibitor and a borate buffer.

B. Any treatment must be compatible with glycol installed in glycol/water systems.

2.3 POT FEEDER

A. Provide a five (5) gallon pot feeder piped around the main closed loop system circulating pumps as indicated on the drawings. The feeder shall consist of a steel tank with operating pressure of 200 psi. A 3½” quick open cap with “O” ring seal shall be provided to add water treatment chemicals.

2.4 COUPON HOLDER

A. Provide coupon rack with coupon holders, flow control and isolation valves. Coupon racks shall be installed in all closed and open hydronic piping systems.

B. Coupon Holders shall be similar to Pulsafeeder, Inc. Model CCR-4.

C. The Water treatment contractor shall install the coupons in the coupon holders and submit a written report to the Owner at the end of each 90 days, during the one year warranty period as to the condition of each system being treated.

2.5 CLOSED SYSTEMS – GLYCOL FEEDER

A. Glycol Feeder Assembly

1. Manufacturers:

a. Advantage Controls
b. J.L. Wingert
c. Neptune
d. Approved equal

2. Provide and install equipment for the automatic feed of a glycol solution. System components shall be as specified.
3. Glycol feeder shall be a packaged system consisting of a storage tank assembly, positive displacement pump, control panel, pressure relief valve, adjustable pressure switch, and low-level switch.
4. Feeder storage tank assembly shall consist of one (1) 50 gallon polyethylene tank with cover equipped with two (2) 3/4” bulkhead fittings located 3” from the bottom of the tank for pump suction and drain. The storage tank shall be mounted on a steel tank stand equipped with a side-mounting platform for the glycol pump.
5. Glycol control panel with red low-level warning light, alarm bell, alarm silence switch and hand/off/auto switch, prewired with terminal strip connections in NEMA 4X enclosure.
6. Pressure relief valve which shall be set at **75 psi**, with relief setting adjustable up to 100psi with an Allen wrench.
7. Pressure switch for glycol pump control shall be adjustable to provide glycol pump start/stop. Ranges: 5 to 65 psi.
8. Low level drum caddy shall shut off glycol pump in the event of low glycol level in storage tank. Caddy shall be wired for pump disconnect and warning device activate circuits.

B. Glycol: An inhibited industrial grade propylene glycol shall be furnished for proper percentage of glycol solution within the system. Refer to Section 23 21 13 for glycol requirements.

C. Test Equipment: Furnish a hydrometer type test kit for the determination of percent/freeze point of propylene glycol solutions.

EXECUTION

3.1 Provide a one year supply, from date of startup, of the recommended formulas for the prevention of scale, corrosion, and biological growth in the recirculating system.

3.2 All formulations must be compatible with system construction materials and meet or exceed all environmental requirements.

3.3 The water treatment company will supply all testing equipment and reagents, necessary to properly maintain the treatment program.

3.4 The water treatment company will provide a water treatment service program for a period of one year from system startup. This program shall include: startup assistance, plant personnel training, monthly service calls and inspection of system equipment. Provide owner with copy of field service report including performance test required levels vs. Field measurements.

3.5 Provide quarterly laboratory analysis and report of coupons.

END OF SECTION

SECTION 23 31 13 - DUCTWORK

PART 1 - GENERAL

1.1 INDUSTRY STANDARDS

A. Construct ductwork to meet all functional criteria defined in Section 11 of the 2005. SMACNA "HVAC Duct Construction Standards, Metal and Flexible", Third Edition. Comply with SMACNA recommendations for fabrication, construction and details, and installation procedures, except as otherwise indicated.

B. Comply with American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE), except as otherwise indicated.

C. Comply with SMACNA "HVAC Air Duct Leakage Test Manual" for testing of duct systems.

1.2 SUBMITTALS

A. Detailed ductwork shop drawings, which include sizes, layouts, and pressure classifications, must be properly submitted. Any ductwork installed without prior written approval by the engineer of record shall be replaced at the expense of the contractor.

B. Shop Drawings: Submit shop drawings for:

1. Transition elbows.
2. Seal and reinforcing schedule for all ductwork fabrication types.
3. Turning vane and turning vane installation.

C. Product Data: Submit manufacturer's product data on the following:

1. Duct lining.
2. Duct lining adhesive.

D. LEED:

1. In addition to meeting the general requirements for VOC emissions, detailed in the LEED Reference Guide, on-site wet-applied products must not contain excessive levels of VOCs, for the health of the installers and other trades workers who are exposed to these products. To demonstrate compliance, a product or layer must meet the following requirements, as applicable. Disclosure of VOC content must be made by the manufacturer. Any testing must follow the test method specified in the applicable regulation.

    a. All paints and coatings wet-applied on site must meet the applicable VOC limits of the California Air Resources Board (CARB) 2007, Suggested Control Measure (SCM) for Architectural Coatings, or the South Coast Air Quality Management District (SCAQMD) Rule 1113, effective June 3, 2011.

b. All adhesives and sealants wet-applied on site must meet the applicable chemical content requirements of SCAQMD Rule 1168, July 1, 2005, Adhesive and Sealant Applications, as analyzed by the methods specified in Rule 1168. The provisions of SCAQMD Rule 1168 do not apply to adhesives and sealants subject to state or federal consumer product VOC regulations.

PART 2 - PRODUCTS

2.1 DUCTWORK MATERIALS

A. All interior ducts shall be constructed with G-90 or better galvanized steel (ASTM A653/653M) LFQ, chem treat. Exterior ductwork or duct exposed to high humidity conditions (i.e., kitchen exhausts) shall also be G-90 or better galvanized steel LFP, chem treat.

B. Ungalvanized carbon steel shall be lockforming grade, hot rolled steel conforming to ASTM A366 or A619.

C. Ductwork designated for painting (by Others) shall be provided with “Paint Lock” finish to accept primer and paint. See Architectural and mechanical documents for designated locations.

2.2 RECTANGULAR DUCT

A. Construct rectangular ductwork to meet all functional criteria defined in Section 11, of the SMACNA “HVAC Duct Construction Standards Metal and Flexible” Current Edition. All ductwork must comply with all local, state and federal code requirements.

B. Where the standard allows the choice of external reinforcing or internal tie rods, only the external reinforcing options shall be used.

C. Pittsburgh lock shall be used on all longitudinal seams. All longitudinal seams will be sealed with mastic sealant. Snaplock is not acceptable.

D. Ductmate or W.D.C.I. proprietary duct connection systems will be accepted. Duct constructed using these systems will refer to the manufacturers guidelines for sheet gauge, intermediate reinforcement size and spacing, and joint reinforcements.

E. Formed on flanges (T.D.C./T.D.F./T-25A/T-25B) shall be constructed as SMACNA T-25 flanges, whose limits are defined on Page 2.76 2005 SMACNA Manual, Third Edition. No other construction pertaining to formed on flanges will be accepted. Formed on flanges shall include the use of corners, bolts and cleat.

F. Ductmate type systems that use a butyl Rubber Gasket which meets Mil-C 18969B, Type II Class B, TT-C-1796 A, Type II Class B, and TTS-S-001657 must also pass UL-723. This material, in addition to the above, shall not contain vegetable oils, fish oils, or any other type vehicle that will support fungal and/or bacterial growth (as defined in 21CFR 177, 1210 closures with sealing gaskets for food containers).

G. Aluminum duct shall be fabricated using the aluminum thickness equivalence table in the standard. Simply increasing the thickness by two gauges is not acceptable.

H. Fittings shall be constructed and reinforced as ductwork according to the longest span.

2.3 ROUND AND OVAL DUCT

A. Round and oval duct shall be galvanized steel, constructed in accordance with Section 11 of the 2005 SMACNA “Duct Construction Standards, Metal and Flexible”, except as.

1. Lighter gauge factory made duct with an Intermediate standing rod may be used. Submit product data sustaining the equivalency of such duct into SMACNA standard duct.

B. Minimum duct gauge shall be 26 gauge.

C. Round ductwork shall be spiral lock seam construction only. Longitudinal seam duct is not acceptable. Gauges shall be in accordance with SMACNA Duct Construction Standard and fittings in accordance with SMACNA Duct Construction Standard, except as noted:

1. Joints 0”-20” diameter, interior slip coupling beaded at center, fastened to duct with sealing compound applied continuously around joint before assembling and after fastening. Wrap joints with 3-inch wide duct tape.
2. Joints 21”-72” diameter, use 3-piece, gasketed, flanged joints consisting of 2 internal flanges (with integral mastic sealant) split to accommodate minor differences in duct diameter, and one external closure band designed to compress gasketing between internal flanges. Example: Ductmate Spiralmate or equal.
3. Joints 73” diameter and up, use companion angle flanged joints only as defined on page 3-6 of the SMACNA Manual. Refer to manual for proper sizing and construction details. Ductwall to be welded longitudinal seams.

D. Fittings shall be continuously welded, standing seam, or spot welded and sealed. Metal thickness and reinforcing shall be equivalent to the requirements of the largest span.

1. All elbows greater than 45” shall be radius type, R=1.5 times duct diameter.
2. Elbows less than 6” shall be of die stamped construction. Elbows 6” or greater shall be 5-gore construction.
3. Diverging and converging flow fittings shall be constructed with no excess material projecting from the body into the branch tap entrance. All such fittings shall be 45° “shoe” entrance, wye plus elbow, or 45° lateral branch. Special fittings such as heel tapped elbows and bullhead tees may be used only where shown on drawings. Adjustable elbows and straight saddle taps shall not be used. Low pressure adjustable elbows acceptable.

E. Where round ductwork 24” and smaller is indicated to be in areas exposed to view, utilize one of the following transverse joining methods:

1. Beaded sleeve connections with duct sealant applied to the sleeve joint prior to attachment.
2. Beaded sleeve connections with gasket integral to sleeve.

No sealant shall be visible on the outside of the duct.

F. Where round ductwork over 24” is indicated to be in areas exposed to view, utilize Van Stone flange joints with non-extruding gasket. No sealant shall be visible on the outside of the duct.

2.4 CONTRACTOR FABRICATED CASINGS AND PLENUMS

A. Unless required otherwise by drawings, single wall casings and plenums may either be contractor or factory fabricated where shown on drawings. All double wall casings and plenums shall be factory fabricated.

B. Casings and plenums shall be constructed in accordance with the 2005 SMACNA “HVAC Duct Construction Standards,” Third Edition and as specified below.

C. All casings and plenums on the suction side of any fan, including return air outside air, or mixing plenum shall be constructed to 2” negative pressure class.

D. Louver blank-off panels shall be constructed to 2” negative pressure class.

E. All casings and plenums for relief and exhaust air shall be 2” positive or negative pressure class.

F. All casings and plenums on the discharge side of supply fans shall be 4” positive pressure class.

G. Single wall plenums shall be of the standing seam type construction. Submit shop drawings indicating overall dimensions, support details, corner and edge details, penetration details, equipment installation details, and pressure class.

H. Seal all seams, edges, and corners with approved duct sealant.

I. Casing materials shall be the same as that for the connected duct systems.

J. Where automatic dampers may, completely shut off air flow and subject plenum of casing to fan close off pressure, install pressure relief panels, rated to open at 125%.

2.5 FACTORY FABRICATED PLENUMS

A. Manufacturers:

1. IAC or approved equivalent.

B. Products:

1. Plenum(s) shall be mounted on a level concrete curb dimension of which shall be as determined by combining standard panel sizes to form the required plenum configuration.
2. Panels shall be 4” thick with interior perforated panel fan sections only sheets of #22-gauge galvanized steel with 3/32” diameter holes spaced on 3/16” staggered centers. Return air plenum to have solid interior panel.
3. Exterior solid panel sheets shall be 18-gauge galvanized steel.
4. Sound retarding and absorbing fill shall be incombustible, inert, mildew resistant and vermin-proof.
5. Internal panel reinforcement shall be a minimum of 18-gauge galvanized steel and spaced so that span does not exceed 2’0”. Perimeter and internal reinforcement and panel sheets shall be welded and riveted to form a rugged metal-sheathed acoustical panel. Spot welds shall not exceed three inch on centers.
6. Prior to attaching the face sheet, the panel shall be filled with sound retardant and absorbing fill as specified above. The fill shall be slightly larger and thicker than the inside dimensions of the panel. No voids will be tolerated.
7. The face sheet shall be welded and riveted to the panel assembly so as to compress and hold the fill materials in place under severe conditions or vibration such as encountered in shipment, installation and operation.
8. Door panels shall be constructed of solid #18-gauge galvanized metal sides. Doors shall be supplied 24” wide x 60” high or 36” wide x 72” high as specified on the drawings. The doors shall be 4” thick of the overlapping seal type. Each door shall be supplied with

single continuous air/acoustic seals around the sill, jambs and head. Doors shall have 2 hinges and 2 latches with an inside release handle. Each floor shall be assembled with hinge hardware attached and adjusted and latches to be installed in field. Door latches are to be the wedge lever type with inside handle. Hinges shall be heavy duty and designed for door size and weight. Doors shall be installed to open against the air pressure.

9. Windows shall be furnished for doors on fan section and shall consist of two layers of ¼" safety glass separated by air space and sealed acoustically and airtight with rubber seals. Air space shall contain a desiccant material to prevent misting.
10. Roof channels, aprons and corner joiners shall be made of #16-gauge galvanized steel formed to prevent a direct path for sound and/or air leakage. Floor channels shall be made of #18-gauge galvanized steel. Panel joiners shall be made of #20-gauge galvanized steel and shall be roll formed to be greater in strength than standard 16 ga. joiners. Where these coil-formed joiner sections are not utilized, 16 ga. shall be provided. All panel accessories shall be furnished in standard lengths to be field cut to required dimensions. Where Ramset cannot be used, floor channels shall be pre-punched with 9/32" holes spaced 24" on centers for attachment by ¼" round head screws with expansion type inserts. All panel joiners and connectors requiring felted surfaces shall have the felt field applied.
11. Opening for fan and duct connections where required shall be provided by the plenum manufacturer. Pipe and conduit penetrations shall be located and cut in the field and sealed in accordance with the manufacturer's instructions.
12. The plenum structure shall be normally self-supporting. Where roof spans and wall loadings require additional structural strength, it shall be furnished either by heavier roof and wall joiners, or additional structural members and/or pipe columns.
13. Metal surfaces shall be galvanized except 5" wide flange beams when used which shall be HR steel prime painted.
14. The manufacturer shall supply, at least 10 days prior to bidding, certified test data in accordance with the following:

    a. The minimum allowable transmission loss (TL) of the panel, including all components, when tested in accordance with ASTM E90-61T, shall be as follows:

TRANSMISSION LOSS IN DECIBELS*								
Octave Band Center Frequencies, HZ	63	125	250	500	1000	2000	4000	8000
Noiseshield	26	23	30	42	51	59	58	58

*Ratings apply to panels in "REGULAR" and "HARD" Constructions.

    b. The composite panel assembly when tested in accordance with ASTM C423-65T, shall have minimum absorption coefficients as follows:

TRANSMISSION LOSS IN DECIBELS*								
Octave Band Center Frequencies, HZ	63	250	500	1000	2000	4000	8000	NRC*
Noiseshield	0.89	1.20	1.16	1.09	1.01	1.03	0.93	(1.10) 0.95

*Ratings apply to panels in "REGULAR" and "HARD" Constructions.

    c. Panels shall have a Hat Transfer Factor of .07 BTU/hour/sq. ft./degree Fahrenheit temperature difference of standard air.
    d. Plenum installation shall be capable of withstanding a positive internal static air pressure of 1 inch.
    e. Plenum installation shall be capable of withstanding a negative internal static air pressure of 6 inches.
    f. Plenum design shall meet the combustion requirements established by ASTM E-84. The panels shall not exceed the following limits:

Flamespread Classification	15
Smoke Developed	0
Fuel Contributed	0

C. Warranty:

Plenum manufacturer shall warrant that when plenum(s) are installed in a workmanlike manner in strict accordance with these specifications and manufacturer's instructions, plenum(s) shall meet the acoustical, thermal and air pressure performance specified.

Plenum components shall be furnished clean, well made and free of any defects which may adversely affect appearance, serviceability or performance. Manufacturer shall furnish proof, satisfactory to the Design Engineer, of having manufactured similar plenums for at least five (5) years prior to this installation.

D. Manufacturer shall submit product information and upon approval by the Engineer shall submit detailed shop drawings with dimensions, and construction details for all systems provided for approval by the Engineer. Assembly of the units shall not begin until all shop drawings have been approved by the Engineer.

2.6 MISCELLANEOUS DUCTWORK MATERIALS

A. General: Provide miscellaneous materials and products of the types and sizes indicated, and where not otherwise indicated, provide type and size required to comply with ductwork system requirements including proper connection of ductwork and equipment.

B. Double wall turning vanes shall be Harper double wall turning vanes fabricated from the same material as the duct. Tab spacing shall be SMACNA standard. Rail systems with non-standard tab spacings shall not be accepted. All tabs shall be used, do not skip tabs. Mounting rails shall have friction insert table, which align the vanes automatically. Vanes shall be subjected to tensile loading and be capable of supporting 250 lbs., when fastened per the manufacturer's instructions. Approved Systems: Ductmate PRO-Rail.

C. Single wall splitter and turning vanes shall be custom fabricated as specified below.

D. Ductwork Support Materials: Except as otherwise indicated, provide galvanized steel fasteners, anchors, rods, straps, trim and angles for support of ductwork.

E. Type FDL – Fiberglass Duct Liner:

1. Manufacturers:

    a. Certainteed
    b. Johns Manville
    c. Knauf
    d. Owens Corning

2. Model: Johns Manville Linacoustic RC with Permacoat (EPA registered antimicrobial coating), in accordance with UL 181, ASTM C1071, G21 and G22 with no observed growth.
3. Compliances:

    a. FSHH-1-545, Type I
    b. NFPA 90-A

4. Roughness: 0.0008 feet
5. Noise Reduction Coefficient: 0.85 or higher for 1-1/2" liner
6. Round Duct Liner: Spiracoustic Plus "snap-in" type with Permacote.

F. Duct Liner Adhesive:

1. Manufacturers:

   a. Childers CP-127 Chil-Quik
   b. CL Ward Duct Liner Adhesive
   c. Design Polymerics DP 2500
   d. Ductmate Industries, Inc. Gecko Glue
   e. Hercules Industries MTA500

2. Description: Water based.
3. UL Listings: UL 723/ASTM E84.

G. Duct Sealant:

1. Manufacturers:

   a. Childers CP-146 Chil-Flex
   b. CL Ward S Seal
   c. Design Polymerics 1010
   d. Ductmate PROseal
   e. Hercules Industries MTS200

2. Description: Non-hardening, water based, liquid or mastic elastic sealant with UV inhibitors for outdoor use
3. UL Listings: UL 181B-M and UL 723/ASTM E84.
4. Sealants shall contain no VOCs.

H. Duct Tape Sealing System:

1. Manufacturers:

   a. Design Polymerics
   b. Hardcast.
   c. Approved equal

2. Model:

   a. Tape: Hardcast DT
   b. Indoor Adhesive: Hardcast FTA-20
   c. Outdoor Adhesive: Hardcast RTA-50

I. Acoustical Duct Lagging:

1. Manufacturers:

   a. Acoustical Solutions
   b. Kinetics Noise Control
   c. Sound Seal

2. Model: Sound Seal B-10 LAG/QFA-3, foil face loaded vinyl or lead barrier sheet fully bonded to a minimum 1” thick fiberglass blanket, nominal density of 1.0psf, install so jacket edges overlap by minimum of 6”, minimum STC-27 tested by independent laboratory in accordance with ASTM E90 and E413, minimum insertion loss (IL) value at 500Hz shall be 23 and meets IMC flame/smoke ratings in accordance with ASTM E84.

J. Fiberglass ductboard is not accepted without prior written approval from the specifier.

K. Access doors shall be hinged or Ductmate Sandwich Type Access Doors manufactured by Ductmate Industries, Inc. Doors shall be of adequate size to allow easy access to hardware, which needs to be maintained.

L. Flexible Duct Connector:

1. Flexible duct connector shall be used where ductwork connects to fans of apparatus, or apparatus casing to fans.
2. Connectors will meet NFPA 90A and 90B specifications and provide an airtight and waterproof seal.
3. Indoor installations shall be Neoprene or vinyl coated fabrics.
4. Outdoor installations shall use Hypalon coated fabric.
5. Connector shall be Ductmate PROFlex or approved equal.

M. Roof-Mounted Duct Supports

1. Description: The Contractor shall design and detail the self-weight support of the roof-top HVAC ducts and their lateral stability to resist WIND and SEISMIC loads. The duct support design shall take into consideration the roof framing load carrying capacity for ME systems supported above and below the roof and distribute the load effect so as not to overload the roof framing. The system shall consist of vertical hot dipped galvanized or stainless-steel frame members or supports with welded 4”x4” base plate for permanent connection to the primary roof framing (not roof decking). The connection points of supports to the roof framing shall be provided with a “pitch pan” and shall be fabricated from the same material as the vertical support members. The “pitch pan” shall interface with roofing membrane, be filled with roofing asphalt, be flashed on all sides, and be provided with a waterproof seal. Mechanical Contractor shall coordinate support system with Roofing Contractor and receive their approval. Provide shop drawings of system for review.

N. Provide seismic restraints as required for seismic zone. See 23 05 49.

2.7 FABRICATION

A. Construct rectangular ductwork to meet all functional criteria defined in Section VII, of the SMACNA “HVAC Duct Construction Standards Metal and Flexible” Current Edition. This shall be subsequently referred to as the SMACNA Manual. All ductwork must comply with all local, state and federal code requirements.

B. All “medium pressure” (systems with external pressures greater than 2” w.c.) duct systems shall be constructed for 4” W.C. positive and 1” W.C. negative static pressure and 3500 FPM velocity.

C. See air handler and fan schedules for external pressure requirements. All pressures above 2” E.S.P. shall be medium pressure.

D. All low-pressure ductwork is to be constructed for 2” W.C. positive and 1” negative static pressure and 2000 FPM.

E. All negative pressure ductwork shall be constructed for a minimum of 2” W.C. negative and 2” W.C. positive static pressure and 2000 FPM velocity.

F. Make all changes in direction using 1.5 radius elbows where possible. Use splitter vanes or mitered rectangular elbows with turning vanes otherwise.

1. Use single thickness splitter vanes for all radius elbows less than 1.5 D = r.

a. D = diameter of duct or width of duct (in plane of change-in-direction).
b. r = radius of duct at duct center-line.
c. Use “Curve Ratios” of 0.45 or greater (as defined by figure 3-7 of the 1989 ASHRAE Fundamentals Handbook).

2. Use single thickness turning vanes with no trailing edges in accordance with SMACNA Standards.

a. All mitered, rectangular elbows in series.
b. All mitered, rectangular elbows less than 36” in width (in plane of change-of-direction).

3. Use double width, airfoil type turning vanes with no trailing edges for all rectangular elbows greater than 36” in width (in plane of change-of-direction).

a. Isolated elbows have a minimum of 3D straight duct upstream and downstream of the change-in-direction.

4. Transfer air elbows are not required to use turning vanes.

G. Fabricate transition elbows with turning vanes at correct angle so entering and leaving edges are parallel or tangent to air flow.

H. All branch duct take-offs shall use 45° laterals or 45° “pants-leg” type fittings.

PART 3 - EXECUTION

3.1 INSTALLATION OF DUCTWORK

A. Assemble and install ductwork in accordance with recognized industry practices, which will achieve air-tight and noiseless systems, capable of performing each indicated service.

B. Install each run with a minimum of joints.

C. Where ducts pass expansion joints or structural elements subject to movement provide flexible connections and supports to allow for movement without adverse effects.

D. Align ductwork accurately at connections, within 1/8” misalignment tolerance and with internal surfaces smooth.

E. Support ducts rigidly with suitable ties, braces, hangers and anchors of the type, which will hold ducts true-to-shape to prevent buckling. This Division is responsible for all duct supports.

F. Seal ducts in accordance with SMACNA requirements for pressure class indicated. Refer to duct leakage testing requirements for required seal class.

1. Indoor Ducts: Use liquid or mastic sealant, or tape system.
2. Outdoor Ducts: Use tape system.
3. Approved manufactured joining systems with gaskets may be used in lieu of transverse sealing.

G. Locate ductwork runs, except as otherwise indicated, vertically and horizontally and avoid diagonal runs wherever possible.

H. Hold ducts close to walls, overhead construction, columns, and other structural and permanent-enclosure elements of the building.

1. Limit clearance to 0.5” where furring is shown for enclosure or concealment of ducts, but allow for insulation thickness, if any.
2. Where possible, locate insulated ductwork for 1.0” clearance outside of insulation.

I. In finished spaces, conceal ductwork by locating in mechanical shafts, hollow wall construction or above suspended ceilings.

J. Where possible, avoid locating ducts on or near floor.

1. Where ducts must be located low, provide metal trestle to protect duct at places where duct will be climbed over.

K. Coordinate the layout with suspended ceiling and lighting layouts and similar finished work.

L. Install access doors where necessary for inspection and maintenance.

1. Provide additional 12” x 12” access door at each low leakage damper.
2. Arrange access doors so that:

    a. They open against the system air pressure wherever feasible.
    b. Their latches are operable from either side, except where the duct is too small to be entered.

3. Provide access doors at all fire damper locations. and all elbows with turning vanes.

M. Where ducts pass through non-fire-rated interior partitions below ceiling and exterior walls:

1. Conceal the space between the construction opening and the duct or duct-plus-insulation with sheet metal flanges of the same gauge as the duct.
2. Overlap the opening on all sides by at least 1-1½”.

N. Provide volume dampers at branch take-offs (except upstream of VAV boxes which should not have dampers).

O. Provide conical or tapered taps with balancing dampers on all round ductwork takeoffs (except upstream of VAV boxes, which should not have dampers).

P. Where space permits, round or oval ductwork of equivalent diameter may be substituted for unlined rectangular ductwork.

Q. Do not modify ductwork in a manner that will increase external static pressure in the system without written approval from Architect/Engineer.

3.2 DUCT LINER INSTALLATION

A. Refer to Application Schedule, 23 07 00.

B. Ducts Exposed to Weather:

1. Seal ducts to three-inch static pressure standards, minimum.
2. Provide a protective aluminum jacket around all exposed surfaces.

C. Ductwork shall be insulated per Section 23 07 00. See Section 23 07 00 for additional insulation requirements on unlined and/or uninsulated ductwork.

1. Coordinate lined duct and insulated duct prior to bid.

D. Seal all exposed ends of liner with duct liner adhesive back a minimum of 2” from ends. Seal all joints in liner a minimum of 1” overlap. Seal all fasteners.

E. Completely remove any loose material from each section of lined ductwork as it is installed.

F. Interrupt duct liner a minimum of 18” upstream and 30 inches downstream of all electric resistance heaters in duct system. If ductwork is used for cooling, wrap that portion of duct which is not lined and extend insulation a minimum of 12” beyond lining in each direction.

G. Dimensions indicated on plans show inside free area.

3.3 DUCT LEAKAGE TESTING

A. Installed ductwork shall be tested prior to installation of access doors, take-offs, etc.

B. All leak testing shall be witnessed by the Engineer or representative of the Engineer. The Contractor shall give the Engineer 72 hours’ notice prior to testing. Any testing not witnessed by the Engineer or their representative, shall be considered invalid and will be redone.

C. The testing shall be performed as follows:

1. Perform testing in accordance with HVAC Air Duct Leakage Test Manual.
2. Use a certified orifice tube for measuring the leakage.
3. Define section of system to be tested and blank off.
4. Determine the percentage of the system being tested.
5. Using the percentage, determine the allowable leakage (cfm) for that section being tested.
6. Pressurize to operating pressure and repair any significant or audible leaks.
7. Repressurize and measure leakage.
8. Repeat steps 6 and 7 until the leakage measured is less than the allowable defined in step 5.

D. All transverse joints and longitudinal seams shall conform to SMACNA’s Class A sealing requirements as defined on page 1.17 of the 2005 SMACNA Manual, Third Edition.

E. Constant Volume Systems/Supply Ductwork

Allowable Leakage	1% of design cfm

F. Constant Volume Systems/Return Ductwork

Allowable Leakage	2% of design cfm

G. Variable Air Volume Systems/Supply Ductwork

Fan to VAV Boxes	1% of design cfm
VAV Boxes to Registers	2% of design cfm

H. Variable Air Volume Systems/Return Ductwork

Allowable Leakage	2% of design cfm

I.	Exhaust Systems	1% of design cfm

J. Extent of Testing

1. Test all sheet metal located within shaft wall construction or concealed behind walls.
2. Test the first 25 percent of duct area of each individual fan system on the project. Testing shall begin at the supply fan or air handling unit discharge for supply air systems or at the exhaust fan or return fan intake for exhaust or return air systems. If all individual fan systems show leakage levels at or below those listed above, remaining ductwork will be permitted to be visually inspected.
3. At Engineer's discretion up to 5 additional tests at random system points may be required.
4. Submit duct testing reports for each individual fan system to Engineer for record.
5. Refer to Section 23 09 03 for additional requirements.

3.4 DUCTWORK STORAGE AND CLEANING

A. Cleaning:

1. Interior surfaces shall be free of dust and debris prior to initial startup. Protect equipment which may be harmed by excessive dirt with filters, or bypass during cleaning. Provide adequate access into ductwork for cleaning purposes. Any cleaning of duct systems shall comply with recommendations of NAIMA and NADCA.
2. When internally cleaning duct work prior to installation or shipment to the jobsite, all duct ends and openings must be covered prior to transporting with a dual Polyethylene protective film. Film must be securely affixed to protect against dirt and debris and must be translucent to facilitate inspection of interior surfaces without removing film. Film must have a minimum elongation of 600%, contain no VOC and leave no residue on duct after removal.
3. Clean external surfaces of foreign substances that might cause corrosion, deterioration of the metal, or where ductwork is to be painted.

B. Protection:

1. Store duct a minimum of 4" above ground or floor to avoid damage from weather or spills.
2. Cover all stored ducts to protect from moisture or debris.
3. Cover all ends of installed ductwork at the end of each workday or when dust and debris producing construction (such as fire proofing, drywall, sanding, or core drilling) is occurring.

C. Ductwork contaminated or damaged above "shop" or "mill" conditions shall be cleaned, repaired or replaced to the Engineer's satisfaction.

1. Ductliner pre-installed in stored duct which has become wet may be installed if first allowed to completely dry out.
2. Ductliner in installed ductwork, which has become wet must be completely removed and replaced.
3. Torn ductliner may be replaced by coating with adhesive if damaged is minor and isolated. Extensively damaged liner shall be replaced back to a straight cut joint.

END OF SECTION

This page is intentionally left blank.

SECTION 23 33 00 - DUCTWORK ACCESSORIES

PART 1 - GENERAL

1.1 INDUSTRY STANDARDS

A. Comply with SMACNA (Sheet Metal and Air Conditioning Contractors' National Association) latest recommendations for fabrication, construction and details, and installation procedures, except as otherwise indicated.

1.2 SUBMITTALS

A. Product Data: Submit manufacturer's product data on the following:

1. Flexible duct
2. Fire dampers
3. Smoke dampers
4. Louvers
5. Sound attenuators

PART 2 - PRODUCTS

2.1 FLEXIBLE DUCT ACOUSTICAL

A. Manufacturers:

1. Flexmaster Type 1M/1B
2. ThermaFlex Type M-KE/G-KM

B. Construction:

1. PE Liner film mechanically locked without adhesives.
2. Insulation: Minimum 1-½" thick fiberglass blanket with a polyethylene vapor barrier. Map 0.23 'c' factor, factory installed.
3. Helix: Corrosion resistant galvanized steel.

C. Pressure rating: 4" w.g. positive, 1" w.g. negative at maximum 180°F operating temperature.

D. Standards: NFPA90A UL-181, Class I, ASTM E-96 - Procedure A.

E. Insertion loss shall be at least:

	OCTAVE BAND (Hz)					
Duct Size	125	250	500	1000	2000	4000
8"	5.6	10.6	23.9	34.0	22.5	17.0
12"	6.6	27.8	22.8	29.0	18.7	10.9
	DB reduction for 6-foot length, straight route, 500 fpm.					

2.2 FLEXIBLE DUCT, HIGH PRESSURE

A. Manufacturers:

1. American/Elgen
2. Flexmaster Type 3
3. Genflex, IGE
4. Thermaflex, MKC

B. Construction:

1. Insulated: Reinforced inner liner, mechanically locked or bonded together by a corrosive resistant galvanized steel helix, Min. 1-½" thick fiberglass blanket with polyethylene vapor barrier. Max. 0.23 'c' factor.
2. Uninsulated: Mechanically locked without adhesives with a corrosion resistant galvanized steel helix.
3. Aluminum: Mechanical lock without adhesives.

C. Pressure rating: 12" w.g. positive, 1" w.g. negative at 180^0F.

D. Standards: NFPA90A, UL-181 Class I, ASTM E96 - Procedure A.

2.3 LOUVERS

A. Louvers are specified in the Architectural Division. This division is responsible for coordinating all duct connections, damper sizes, etc. with the louvers specified.

2.4 INTAKE PENTHOUSES

A. Manufacturers:

1. Air Balance
2. Arrow United Industries
3. AWV
4. Commercial Acoustics
5. Cook
6. Greenheck
7. Louvers & Dampers, Inc.
8. Pottorff
9. Ruskin
10. Safe-Air Dowco
11. Wonder Metals

B. Construction: 12-gauge aluminum, braced for 30 psf wind load. Structural support and flashing for installation on roof curb.

2.5 PREFABRICATED CURBS

A. General: Except where curbs are provided with equipment, provide prefabricated curbs for all roof-mounted equipment.

B. Manufacturers:

1. Pace
2. RPS
3. Thycurb

C. Model for grease-laden exhaust fans: ES-2.

1. Coordinate to fit vibration isolation rail.

D. Coordinate with roofing Contractor. Exterior insulation, cants, flashing and counter flashing shall be furnished and installed under roofing work, Division 7.

E. Model: As required.

2.6 SOUND ATTENUATORS

A. Manufacturers:

1. Aerosonics
2. IAC Acoustics
3. Kinetics
4. Pottorff
5. Ruskin
6. Semco
7. Vibro Acoustics

B. Acoustical Performance

1. All duct silencer performance data shall be derived from National Voluntary Laboratory Accreditation Program (NVLAP) accredited laboratory tests in accordance with ASTM E477-99, Standard Test Method for Measuring Acoustical and Airflow Performance of Duct Liner Materials and Prefabricated Silencers. Submit certification of acoustical and aerodynamic performance.

2.7 INTAKES AND RELIEF VENTS

A. Manufacturers:

1. Acme
2. Carnes
3. Greenheck
4. Loren Cook
5. PennBarry

B. Construction: Aluminum panels, bird screen.

C. Pressure Drop: .05” at 500 fpm throat velocity.

2.8 FIRE DAMPERS

A. Manufacturers:

1. Air Balance
2. Greenheck
3. Johnson Controls
4. Nailor
5. NCA
6. Pottorff
7. Prefco
8. Ruskin
9. Safe-Air Dowco
10. United Enertech

B. Rating: UL555 dynamic 1-½ hours, or 3 hours, UL555S Class II leakage rated. Match construction penetrated.

C. Size: Metal-to-metal for lined and unlined ducts.

D. For curtain type, use Type B “Top Hat” wherever possible.

E. Integral factory-mounted access door.

2.9 FIRE/SMOKE DAMPERS

A. Manufacturers:

1. Air Balance
2. Greenheck
3. Johnson Controls
4. Nailor
5. NCA
6. Pottorff
7. Prefco
8. Ruskin
9. Safe-Air Dowco
10. United Enertech

B. Fire Damper Rating: UL Standard 555 Dynamic, 1-½ hour or 3 hours.

C. Smoke Damper Rating: UL Standard 555S, Class II.

D. Damper Assembly:

1. Type: 120-Volt.
2. Listing: UL 555S, UL555.
3. Rating: Match wall rating.
4. Failure Position: Fail closed.
5. Heat Sensor: 165°F heat sensor.
6. Blade: Air foil.
7. Seals: Mechanically fastened, rated up to 450°F.
8. Integral factory-mounted access door.

E. Where part of Smoke Control System.

1. Provide end switch for positive indication of damper position.
2. Provide means to re-open damper remotely in the event thermal link trips. Allow for re-open up to elevated rating of 250°F.

2.10 SMOKE DAMPERS

A. Manufacturers:

1. Air Balance
2. Greenheck
3. Johnson Controls
4. Nailor
5. NCA
6. Pottorff
7. Prefco
8. Ruskin
9. Safe-Air Dowco
10. United Enertech

B. Smoke Damper Rating: UL Standard 555S, Class II.

C. Operator:

1. Type: 120-Volt.
2. Listing: UL Smoke Damper Operator Label.
3. Failure Position:

a. Smoke control system dampers: As shown on plans.
b. Others: Closed

4. UL listed modulating actuator at dampers that are part of smoke control system.

D. Blade: Air foil.

E. Seals: Steel.

F. Integral factory-mounted access door.

G. Where part of smoke control system:

1. Provide end switch for positive indication of damper position.

2.11 MISCELLANEOUS DUCTWORK ACCESSORIES

A. Duct Access Doors: Provide duct access doors with gaskets, door hinge, and with insulation where ductwork is indicated to be insulated.

1. Manufacturers:

a. Greenheck
b. Ductmate

c. Elmdor
d. Flexmaster
e. Milcor

B. Flexible Connectors:

1. Manufacturers:

a. Cain Thermolon
b. Carlisle Connector Plus w/Silicone Hi-T
c. Duro-Dyne Thermafab
d. Ductmate PROFlex with Silicone

2. Material: Glass fabric with silicone coating.
3. Rating: ASTM E84 or UL 723

a. ASTM E84

1) Flame Spread less than 25
2) Smoke Developed less than 50

2.12 BACKDRAFT AND PRESSURE RELIEF DAMPERS

A. Manufacturers:

1. Greenheck
2. Nailor
3. Pottorff
4. Ruskin
5. Safe-Air Dowco
6. United Enertech

B. Construction:

1. Frame: Extruded aluminum.
2. Blades: Formed aluminum with extruded vinyl edge seals.
3. Bearings: Synthetic
4. Downflow: Provide gravity type counter-balanced damper with zinc plated steel weights
5. Upflow or Horizontal Flow: Provide gravity type damper with or without zinc plated steel weights

C. Performance: 12 cfm per square foot at ½" W.G.

2.13 BALANCING DAMPERS

A. Construction:

1. Frame: 16-gauge galvanized steel.
2. Blades: 16-gauge galvanized steel with vinyl edge seals.
3. Bearings: Heavy duty nylon.

4. Performance:

    a. Maximum pressure drop in full open position (@3000 fpm): 0.55
    b. Maximum leakage: 32 cfm/sp at 4" W.C.

B. Type: Rectangular balancing dampers are to be opposed blade type with locking handle, unless otherwise noted.

PART 3 - EXECUTION

3.1 INSTALLATION OF ACCESSORIES

A. Install fire, smoke and ceiling dampers in accordance with manufacturer's instructions and the latest version of the Fire, Smoke and Radiation Damper Guide for HVAC Systems, published by SMACNA.

B. Install access doors where necessary for inspection and maintenance.

1. Provide additional 12" x 12" access door at each low leakage damper.
2. Arrange access doors so that:

    a. They open against the system air pressure, wherever feasible.
    b. Their latches are operable from either side, except where the duct is too small to be entered.
    c. Install flexible connectors at all duct connections to rotating or reciprocating machinery or equipment.

3. Provide access doors at all fire damper locations. and all elbows with turning vanes.

C. Use HIGH PRESSURE flexible duct where shown upstream of VAV boxes.

D. Notify fire alarm provider of smoke damper control requirements and fire alarm interlocks.

E. Install flexible ductwork without tight bends and free of kinks.

1. Flexible ductwork shall not be less than 4', nor exceed 8' in length.
2. Flexible ductwork shall be installed with a "minimum length of straight duct" upstream of the diffuser neck inlet. "A minimum length" shall mean a length equal to three (3) duct diameters. "Straight duct" shall mean the center-line of the duct shall be aligned with a line perpendicular to the plane of the diffuser neck opening at the center point of the opening.
3. Conform to the detail on the drawings.

F. Install all dampers, including those furnished by Section 23 09 00 Contractor.

1. Caulk damper frames to ductwork.
2. Make sure dampers are free to operate properly.
3. Install parallel blade mixing dampers to two streams impinge on each other to facilitate mixing.

G. Provide balance dampers at branch take-off and where required to minimize balancing performed at diffuser face.

H. Provide all balance dampers as shown on plans and any additional dampers necessary to provide a balanced system meeting all sound requirements.

END OF SECTION

SECTION 23 34 00 - FANS

PART 1 - GENERAL

1.1 QUALITY CONTROL

A. Provide fans with AMCA performance certification and label.

B. Grease exhaust fan shall comply with NFPA 96 and be UL listed.

C. Fans serving dishwashers shall be UL listed and appropriate for moisture laden air application.

D. All fans 7.5 HP and below to be provided with an adjustable pulley to accommodate proper balancing.

E. All spun-aluminum fans to be provided with a belt tensioner and a two-section motor cover allowing access to motor and belts without the use of tools.

F. Fans utilized for smoke exhaust or pressurization shall comply with the following:

1. Provide 1.5 times the minimum number of belts required for normal operation with a minimum of 2.
2. Fans shall be selected for stable operation at normal temperatures and at elevated temperatures of 250°F.
3. Components shall be rated and certified by the manufacturer for temperatures up to 250°F.

1.2 MOTOR HORSEPOWER

A. Do not increase or decrease motor horsepower from that specified without written approval from Architect/Engineer. See Section 23 05 01.

1.3 SUBMITTALS

A. Manufacturer’s Data: Submit manufacturer’s product data including:

1. Performance
2. Size
3. Type
4. Options provided
5. Fan curves
6. Indicate Compliance with Section 1.1 where applicable.

PART 2 - PRODUCTS

2.1 POWER ROOF VENTILATORS, CENTRIFUGAL

A. Manufacturers:

1. Acme
2. Aerovent
3. Carnes
4. Cook
5. Greenheck
6. New York Blower
7. PennBarry
8. Twin City

B. Features:

1. Downblast configuration
2. Spun aluminum housing
3. Internal rubber vibration isolators
4. Ball bearings

C. Accessories:

1. Bird screen
2. Gravity back-draft damper:

    a. 0.2-inches WC max. pd.

3. Motorized type backdraft damper where indicated

D. Roof Curb:

1. Curbs will be provided under another Division
2. Provide dimension data to Supplier of roof curbs
3. Provide factory fabricated roof curb of height required by local authorities

E. Sound Criteria:

1. Required sound levels may be attained by use of sound attenuating curbs
2. Fan shall have specified capacity with curb in place
3. Curb pressure drop is not included in specified ratings

2.2 UP-BLAST ROOF EXHAUSTER

A. Manufacturers:

1. Acme
2. Aerovent
3. Carnes
4. Cook
5. Greenheck
6. New York Blower
7. PennBarry
8. Twin City

B. Features:

1. Upblast exhaust configuration
2. Spun aluminum housing

3. Outside air motor cooling
4. Grease trough
5. Internal rubber vibration eliminators
6. UL listed for grease laden air where noted on drawings

C. Accessories:

1. Bird screen

D. Roof Curb:

1. Curbs will be provided under another Division
2. Provide dimension data to Supplier of roof curbs
3. Provide factory fabricated roof curb of height required by local authorities

2.3 RESIDENTIAL CABINET FAN

A. Manufacturers:

1. Broan
2. Delta Breez
3. Panasonic

B. Features:

1. Steel cabinet
2. Centrifugal fan wheel
3. Integral backdraft damper
4. Wall switch

C. Accessories:

1. Multi-speed fan motor with selector switch
2. Humidity sensor
3. Integral light
4. UL 555C ceiling radiation damper

2.4 CABINET FAN

A. Manufacturers:

1. Acme
2. Aerovent
3. Carnes
4. Cook
5. Greenheck
6. New York Blower
7. PennBarry
8. Twin City

B. Features:

1. Steel cabinet, acoustically insulated

2. Centrifugal wheel
3. Integral backdraft damper

C. Accessories:

1. Provide rheostatic speed controller for all direct drive fans. Mount under grille or on wall as specified in the drawings.

2.5 IN-LINE CENTRIFUGAL FAN

A. Manufacturers:

1. Acme
2. Aerovent
3. Carnes
4. Cook
5. Greenheck
6. New York Blower
7. PennBarry
8. Twin City

B. Features:

1. Steel cabinet, baked enamel finish
2. Cast aluminum wheel, statically and dynamically balanced
3. Cast aluminum hub
4. Fan access sections shall be provided with gasketed seal.
5. Heavy duty pillow block bearings within fan housing with external grease fittings
6. Belt guard
7. Drive: See schedule

C. Accessories:

1. Access panel.

2.6 BELTED VENTILATING SETS (UTILITY FANS)

A. Manufacturers:

1. Acme
2. Aerovent
3. Carnes
4. Cook
5. Greenheck
6. New York Blower
7. PennBarry
8. Twin City
9. Design Basis: Twin City.
10. Other Acceptable Manufacturers:

a. Ammerman
b. Barry
c. Cook

d. Greenheck
e. New York Blower
f. Trane
g. Twin City

B. Features:

1. Welded steel housing
2. Backward inclined fan wheel
3. Pillow block bearings, average life 200,000 hours
4. Adjustable V-belt drive

C. Accessories

1. For Outdoor Units: Motor weather cover.
2. For Indoor Units: Belt guard.

2.7 SIDEWALL PROPELLER FAN

A. Manufacturers:

1. Acme
2. Aerovent
3. Carnes
4. Cook
5. Greenheck
6. New York Blower
7. PennBarry
8. Twin City

B. Features:

1. Steel panel
2. Steel tube frame
3. Welded steel wheel
4. Pillow block bearings with external grease fittings
5. Belt drive

PART 3 - EXECUTION

3.1 NOISE AND VIBRATION

A. Insure that fans are properly supported on vibration isolators. Reference Section 23 05 48 for Vibration Isolation Requirements.

B. Insure that flexible duct connections are properly made.

C. Check fan for improper balance.

1. Have fan re-balanced if necessary.

D. Check for proper rotation.

E. Check for unusual noise or vibration and correct as necessary.

3.2 ACCESS

A. Provide for proper access to all parts of fan needing inspection or service with access doors in fan or ductwork.

3.3 INSTALLATION

A. Install units level and plumb.

B. Provide necessary auxiliary supporting steel.

C. Mount motor and drives so belts run true.

D. Provide flexible duct connections on inlet and discharge.

3.4 CURBS

A. Provide necessary dimensions and details so roof opening can be provided at the proper time.

B. Coordinate delivery of curb with roofing contractor so project is not delayed.

C. Provide a weatherproof installation:

1. Seal all joints including, but not limited to:

a. Unit and curb.
b. Unit and ducts.

END OF SECTION

SECTION 23 36 00 - AIR TERMINAL UNITS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Variable volume terminal units.

B. Variable volume regulators.

C. Integral heating coils.

D. Integral damper motor operators.

E. Integral controls.

1.2 PRODUCTS FURNISHED BUT NOT INSTALLED UNDER THIS SECTION

A. Section 23 09 00 - Controls and Instrumentation: Thermostats and control components.

1.3 REFERENCES

A. NFPA 90A - Installation of Air Conditioning and Ventilation Systems.

B. UL 181 - Factory-Made Air Ducts and Connectors.

C. ARI 880 - Air Conditioning and Refrigeration Institute Standard Rating Conditions for Air Terminals.

D. UL - Shutoff terminal must be UL listed as a Room Air Terminal.

E. ASTM A 527 (Steel Sheet, Zinc Coated Galvanized)

1.4 SUBMITTALS

A. Submit shop drawings and product data sheets indicating configuration, general assembly, and materials used in fabrication.

B. Submit product data indicating configuration, general assembly, and materials used in fabrication. Include catalog performance ratings which indicate air flow, static pressure, and radiated sound power levels (2nd through 7th octave bands) at design maximum operating conditions. Also submit Radiated Sound NC values. Shall be calculated at design conditions with the following path attenuation credits:

CORRECTION TO OCTAVE BAND SOUND POWER VALUE						
	2	3	4	5	6	7
Env Adj	-3	-2	-1	-1-	-1	-1
Mineral Fiber Ceiling Tile	-9	-10	-12	-14	-15	-15
Space Effect Factor	-10	-11	-12	-13	-13	-14

This transfer function represents modeling assumptions based on ARI 885-90.

C. Submit manufacturer's installation instructions.

1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the products specified in this section with minimum ten years of experience.

1.6 WARRANTY

A. Provide one year manufacturer's parts warranty.

PART 2 - PRODUCTS

2.1 SINGLE DUCT VAV BOXES

A. Manufacturers:

1. Carrier
2. Enviro-Tec
3. Johnson Controls
4. Krueger
5. Metal Aire
6. Nailor
7. Price
8. Siemens
9. Titus
10. Trane

B. Sound Criteria:

1. Conform to ARI 880 performance test standard.

2. Discharge Sound:

    a. 0.2” SP: NC40
    b. 1.0” SP: NC53

3. Radiated Sound:

    a. 0.2” SP: NC27
    b. 1.0” SP: NC41

4. Sound levels may be attained using attenuators, but pressure drop of attenuator must be included as part of unit pressure drop.

    a. Units will discharge into lined or fiberglass ductwork, credit for which cannot be claimed in sound criteria.

C. Duct Connections:

1. Duct connections shown on drawing are minimum.
2. Units with larger connections may be used to meet pressure or sound requirements.
3. Flexible duct shall be same size as unit connection.

D. Construction:

1. Galvanized steel, ½” lining, conforming to UL181 and NFPA90A.
2. Maximum leakage not exceeding 1% design flow.

E. Heating Coils:

1. Refer to Section 23 82 16 coils.

F. Control:

1. Electronic, using velocity sensor, with compensation or correction for distorted flow at inlet.
2. Maximum and minimum volume controls shall be:

    a. Factory set (with allowance for altitude of project).
    b. Accurate within 10%.

3. Units shall be normally open with reversing relay for use with direct acting thermostat.
4. Provide electric motor.
5. Coordinate spring range with Automatic Temperature Control Section.
6. Coordinate controls on VAV units with control contractor.

2.2 SOUND PERFORMANCE

A. Terminal units shall not exceed the scheduled sound criteria.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

END OF SECTION

SECTION 23 37 00 - AIR INLETS AND OUTLETS

PART 1 - GENERAL

1.1 CEILING CONSTRUCTION

A. Provide products compatible with ceiling construction.

1.2 SUBMITTALS

A. Submit catalog data including throw, sound, pressure drop and physical dimensions.

1.3 INDUSTRY STANDARDS

A. Provide products tested in accordance with ASHRAE 70-1991 150 Standard 5219, 150 Standard 3741.

PART 2 - PRODUCTS

2.1 GRILLES AND RECTANGULAR DIFFUSERS

A. Manufacturers:

1. Krueger
2. Metal Aire
3. Nailor
4. Price
5. Titus

B. Material: Steel or aluminum except:

1. Where noted otherwise.
2. Where required otherwise for fire rating.
3. Grilles and diffusers in locker rooms, showers and toilet rooms in locker rooms to be aluminum.

C. Finish: Baked white enamel except where noted.

D. Refer to the Drawings for required performance.

E. Match frame and border types to ceiling system.

2.2 SLOT DIFFUSERS WITH FACTORY-SUPPLIED PLENUMS

A. Manufacturers:

1. Krueger

2. Metal Aire
3. Nailor
4. Price
5. Titus

B. Material: Steel or aluminum except:

1. Where noted otherwise.
2. Required otherwise for fire rating.

C. Finish: Baked white enamel except where noted.

D. Inlet Size: Match duct size.

E. Match frame and border types to ceiling system.

PART 3 - EXECUTION

3.1 GENERAL

A. Refer to architectural reflected ceiling plan for exact locations and ceiling types.

B. Provide all support and framing devices necessary.

C. Exposed mounting screws:

1. Use tamper proof screws in countersunk holes.
2. Point screws to match frame.

D. Fire Rated Ceilings:

1. Provide insulation equivalent to ceiling construction above diffuser between ceiling opening and ceiling damper.

E. Install security type devices in accordance with manufacturer’s directions.

END OF SECTION

SECTION 23 40 00 - AIR CLEANING

PART 1 - GENERAL

1.1 SUBMITTALS

A. Submit manufacturer's product data including:

1. Media:

   a. Description
   b. Efficiency
   c. Test method

2. Enclosure
3. Support requirements
4. Weight
5. Electrical data
6. Drawings showing dimensions

1.2 QUALITY CONTROL

A. All filters shall be listed as class II per UL Standard 900.

PART 2 - PRODUCTS

2.1 1" MERV 8 PANEL FILTERS

A. Manufacturers:

1. Air Guard Type DP/DP Max
2. American Air Filter PREpleat LPD
3. Camfil Aeropleat IV

B. Media and Performance:

1. Non-woven cotton/synthetic.
2. MERV 8 filter efficiency per ASHRAE Standard 52.2-2012.
3. Not less than 2.3 square feet of media area per square foot of filter face area.
4. Not more than 0.25" WG initial resistance at 500 FPM.
5. Capable of 1.0" WG final resistance.

C. Support

1. Wire grid media support to maintain radial pleats.
2. Beverage board frame and diagonal supports.

2.2 2" MERV 8 PANEL FILTERS

A. Maintenance:

1. Air Guard Type DP/DP Max
2. American Air Filter PrePleat 40 LPD
3. Camfil Farr 30/30

B. Media and Performance:

1. Non-woven cotton/synthetic
2. MERV 8 filter efficiency per ASHRAE Standard 52.2-2012.
3. Clean filter efficiency of 23% at one micron.
4. Not less than 2.5 square feet of media area per square foot of filter face area.
5. No more than 0.31" WG initial resistance at 500 FPM.
6. Capable of 1.0" WG final resistance.

C. Support

1. Welded wire grid to maintain pleat shape.
2. Beverage board frame and diagonal supports.

2.3 4" MERV 13 PANEL FILTERS

A. Manufacturers:

1. Air Guard Type DP-green
2. American Air Filter PrePleat M13
3. Camfil Farr AP-Thirteen

B. Media and Performance:

1. Microfine glass media in a uniform high loft media blanket.
2. MERV 13 filter efficiency per ASHRAE Standard 52.2-2012.
3. Not more than 0.50" WG initial resistance at 500 FPM.
4. Capable of 1.5" WG final resistance.

C. Support

1. Welded wire grid to maintain pleat shape.
2. Beverage board frame and diagonal supports.

2.4 12" MERV 13 CARTRIDGE FILTERS

A. Manufacturers:

1. Air Guard VariPak
2. American Air Filter Varicel RF
3. Camfil Riga-Flo

B. Media and Performance:

1. Microfine glass media in a uniform high loft media blanket.

2. MERV 13 filter efficiency per ASHRAE Standard 52.2-2012.
3. Not more than 0.50” WG initial resistance at 500 FPM.
4. Capable of 1.5” WG final resistance.

C. Support

1. Rigid cartridge type.
2. Welded wire grid to maintain pleat shape.
3. Contour stabilizers to maintain pleat spacing.
4. Galvanized steel enclosure and diagonal supports.
5. Capable of withstanding 10” S.P. drop without noticeable distortion.

2.5 FILTER GAUGES

A. Dwyer Magnehelic Series 2000.

B. Provide mounting bracket, tubing, static pressure tips and vent valves.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Locate filter banks to allow for access and prevent interference or damage by other components such as dampers and humidifiers.

B. Provide vertical and horizontal stiffening bars, blank offs, angle flashing as necessary to install built up filter banks in plenum. Gasket or caulk between frame members, flashings, and blank offs.

C. Provide filter gauges to measure pressure drop of all filter banks with 2” MERV 8, 4” MERV 13, or 12” MERV 13 filters.

D. Electric filters shall be installed at the air handler manufacturers factory and field tested by the filter manufacturer. Filter manufacturer shall provide start up for the filters.

E. Contractor shall provide a filter replacement matrix schedule for each unit indicating size and filter type.

F. Provide and install a clean set of filters in all equipment prior to turn over to owner and one spare filter for each unit. For units with multiple filters provide a spare filter for each type.

END OF SECTION

This page is intentionally left blank.

SECTION 23 52 00 - BOILERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplemental Conditions of the Construction Contract and Division 1 Specification Sections (General Requirements), apply to this Section.

1.2 QUALITY ASSURANCE

A. ASME Code Symbol Stamps: Provide boilers and safety (pressure relief) valves complying with ASME Code and stamped with appropriate code symbols.

B. Hydronics Institute Insignia: Provide cast-iron boilers, which have been I-B-R (Institute of Boiler and Radiator Manufacturers) performance rated and have affixed the I-B-R insignia of the Hydronics Institute.

C. Submittals:

1. Submit manufacturer’s product data.

D. General Requirements for Boiler Suppliers:

1. The Boiler Representative shall be an authorized representative of the Boiler manufacturer and shall have been actively engaged with this manufacturer and in this field of operation for not less than five years. The installing contractor or boiler supplier shall have a service department as a permanent and integral part of their company with 24-hour service available at all times. The contractor or boiler supplier’s stocking warehouse shall be no more than 100 miles from the jobsite and stock standard replacement parts for the boiler.
2. The entity responsible for boiler service during the warranty period and their 24-hour service phone number shall be specified in the O & M manual.
3. The boiler representative shall provide a factory trained and factory authorized representative to perform the following:

    a. Verify proper installation of boiler.
    b. Verify proper wiring of controls and for proper operation of the controls in accordance with the boiler listing, manufacturer’s directions and Sequence of Operation given in Section 23 09 00.

1.3 REGULATORY REQUIREMENTS

A. Comply with the requirements of all authorities having jurisdiction including but not limited to:

1. State Boiler Inspector.
2. Local Building Department.
3. Owner’s Insurance Carrier.

B. Provide all operating controls, safety controls, low water cut outs, and other components required for the occupancy of the building and the size of the boiler.

PART 2 - PRODUCTS

2.1 BOILER (ELECTRIC)

A. Manufacturers:

1. Bryan
2. PVI
3. Approved equal

B. Pressure Vessel:

1. The steel pressure vessel shall be constructed and stamped in accordance with Section IV, Part H of the ASME boiler and Pressure Vessel code.
2. The boiler shall be rated as shown on the schedule.
3. The pressure vessel shall be National Board Registered for a working pressure of 125 psi and shall be pressure tested at 1-1/2 times working pressure. The pressure vessel shall be constructed with tappings for safety relief valve, drain and blowdown valve, and cleanout and inspection openings as required by the ASME code
4. Supply and return connections shall be 3000 pound NPT couplings up to and including 2” pipe size. Above 2” pipe size, supply and return connections shall be standard 150 lb. ANSI flanges.

C. Elements and Power Circuits

1. Each element shall be sheathed in incoloy.
2. Each element may, as an option, be electroless nickel plated for additional corrosion protection.
3. Each element shall individually mount to the tank by means of a four-bolt bronze flange over stainless-steel studs. An o-ring shall seal the connection.
4. A fused magnetic contactor shall be supplied for each power circuit

    a. Maximum current per circuit will be 50 amps on three-phase units.

D. Safety Controls

1. As a minimum, the boiler shall be equipped with the following:

    a. Manual reset electronic low water cutoff
    b. One direct immersion operating thermostat
    c. One manual reset, direct immersion temperature limiting device
    d. ASME rated pressure relief valve
    e. Solid-state proportional sequencer

E. Warranty Summary

1. The elements and all boiler parts shall have a one-year warranty
2. For a period of one year the manufacturer shall pay all material, labor and freight costs necessary to repair any failed part on the boiler.

3. For a period of one year the manufacturer shall return the boiler to operating condition if it should leak due to a defect in material or workmanship.
4. Complete companies of all warranties, including all exclusions and conditions, must be presented to the Owner as part of the submittal package.

F. Assembly

1. The boiler shall be completely packaged, requiring only hookup for electrical and plumbing
2. The boiler shall be insulated with multiple layers of heavy-density fiberglass, jacketed with powder-coated steel panels, and mounted on heavy-duty I-beam skids.
3. The boiler shall fit properly in the space provided and installation shall conform to all local, state and national codes.

PART 3 - EXECUTION

3.1 FIELD ASSEMBLY

A. Assemble boiler at the job site in an area designated by the Owner, convenient for installation.

B. Comply with all manufacturers' requirements.

C. Upon completion of assembly, contact Engineer and manufacturer's representative for field observation.

3.2 CLEANING

A. Flush and clean boilers upon completion of installation in accordance with manufacturer's instruction.

B. Include boiler in system for cleaning covered in Section 23 21 13.

3.3 FIELD QUALITY CONTROL

A. Test assembled boiler, boiler piping and accessories, including, but not limited to, safety and safety relief valves, gauges, etc., in accordance with applicable sections of ASME Boiler and Pressure Vessel Code.

B. Arrange with Owner's insurance carrier and State Boiler Inspector for inspection and certification of completed boiler unit.

C. Instruct the Owner's Representative in the proper operation of the boiler in the presence of the Boiler Representative.

3.4 WATER QUALITY

A. Initial fill of boiler water system shall be treated with softeners and/or inhibitors as recommended by Boiler Manufacturer.

B. Submit a water quality analysis by a qualified water treatment company to Boiler Manufacturer for their use in recommending water treatment.

C. Submit water quality analysis and treatment recommendations to Engineer for review and comment.

3.5 START UP

A. Manufacturer representative shall provide factory trained personnel to start up and checkout boilers. Adjust burner to provide optimum combustion as determined from flue gas analysis.

END OF SECTION

SECTION 23 64 23 - AIR COOLED SCROLL HEAT PUMP WATER CHILLERS

PART 1 - GENERAL

SECTION INCLUDES

Chiller package.

A. Charge of refrigerant and oil.

B. Controls and control connections.

C. Chilled water connections.

D. Starters.

E. Electrical power connections.

1.2 RELATED SECTIONS

A. Section 23 23 00 - Refrigerant Piping.

B. Section 23 09 00 –Building Automation and Automatic Temperature Control System.

1.3 REFERENCES

A. ANSI/ARI 550/590 - Centrifugal or Rotary Water - Chilling Packages.

B. ANSI/ASHRAE 15 - Safety Code for Mechanical Refrigeration.

C. ANSI/ASHRAE 90.1 - 2004 - Energy Conservation in New Building Design.

D. ANSI/ASME SEC 8 - Boiler and Pressure Vessel Code.

E. ANSI/NEMA MG 1 - Motors and Generators.

F. ANSI/UL 465 - Central Cooling Air Conditioners.

G. ANSI/UL 984 - Safety Standard for Hermetic Motor Compressors.

H. ANSI/AFBMA 9-1978 - Load Ratings and Fatigue Life for Ball Bearings. Bearings must have life of not less than 200,000 hours.

I. ASTM B117 - Standard Method of Salt Spray (Fog) Testing.

J. ASTM A123 - Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

K. ASTM A525 - Zinc (Hot-Dip Galvanized) Coatings on Sheet Steel Products.

L. ASTM D1654 - Evaluation of Painted or Coated Specimens, Subjected to Corrosive Environments.

1.4 QUALITY ASSURANCE

Factory Test: Chiller shall be pressure-tested, evacuated and fully charged with refrigerant and oil, and shall be factory operational run tested with water flowing through the vessel.

A. Unit shall be delivered to job site fully assembled, and charged with refrigerant and oil by the Manufacturer. Cover unit with shrink wrapping or tarping to protect unit during shipping to the jobsite.

B. Unit shall be stored and handled per Manufacturer's instructions.

1.5 SUBMITTALS

A. Submit drawings indicating components, assembly, dimensions, weights and loadings, required clearances, and location and size of field connections. Indicate accessories where required for complete system.

B. Submit product data indicating rated capacities, weights, specialties, and accessories, electrical requirements and wiring diagrams.

C. Submit manufacturer's installation instructions.

1.6 OPERATION AND MAINTENANCE DATA

A. Submit operation data.

B. Include start-up instructions, maintenance data, controls, and accessories.

C. Submit maintenance data.

1.7 REGULATORY REQUIREMENTS

A. Conform to ANSI/ARI 550/590 Standard for testing and rating of Centrifugal and Rotary Screw Water - Chilling Packages.

B. Conform to ANSI/UL 465 code for construction of water chillers and provide UL label. In the event the unit is not UL approved, the manufacturer shall, at their expense, provide for a field inspection by an UL representative to verify conformance to UL standards. If necessary, contractor shall perform modifications to the unit to comply with UL, as directed by the UL representative.

C. Conform to ANSI/ASME SEC 8 Boiler and Pressure Vessel Code for construction and testing of water chillers.

1.8 STORAGE AND HANDLING

A. Comply with manufacturer's installation instructions for rigging, unloading, and transporting units.

B. Protect units from physical damage. Factory coil shipping covers shall be kept in place until installation.

C. Unit controls shall be capable of withstanding 203 Deg F (95 Deg C) storage temperatures in the control compartment for an indefinite period of time.

1.9 WARRANTY

A. Provide a full parts and labor warranty for one year from start-up or 18 months from shipment, whichever occurs first.

B. Provide fiveyear warranty for replacement compressors including material and labor.

PART 2 - PRODUCTS

2.1 SUMMARY

A. The contractor shall furnish and install air-cooled water chillers and shown as scheduled on the Contract Documents. The chillers shall be installed in accordance with this specification and perform at the specified conditions as scheduled. Equipment connections shall be limited to a single point electrical connection, a single chilled water supply and return connection and a single condenser water supply and return connection. Any additional connections required for oil coolers, variable speed drives, etc. are not permitted.

B. APPROVED MANUFACTURERS

1. Carrier:
2. Daikin Applied:
3. Quantech:
4. Trane:
5. York:
6. Substitutions: Prior approval required as indicated under the general and/or supplemental conditions of these specifications.

2.2 GENERAL UNIT DESCRIPTION

A. Provide factory assembled and tested outdoor air-cooled liquid chillers consisting of scroll compressors, condenser, evaporator, thermal or electronic expansion valve, refrigeration accessories, starter and control panel. Construction and ratings shall be in accordance with ANSI/ARI 550/590.

B. See schedule for air-cooled water chiller minimum IPLV rating (Integrated Part Load Value) based on ARI Standard 590-92.

2.3 COMPRESSORS

A. Provide hermetic scroll compressors. Compressors shall be industrial grade, energy efficient direct drive 3600 RPM maximum speed scroll compressor type. The motor shall be a suction-gas cooled hermetic design. A solid state temperature sensor shall be embedded in the motor windings to protect against excessive winding temperatures.

B. Statically and dynamically balance rotating parts.

C. Provide oil lubrication system with oil charging valve and oil filter to ensure adequate lubrication during starting, stopping, and normal operation.

D. Provide compressor with automatic capacity reduction equipment consisting of compressor staging . Use lifting mechanism operated by oil pressure. Compressor must start unloaded for soft start on motors.

E. Provide constant speed 3600 rpm compressor motor, suction gas cooled with solid state sensor and electronic winding overheating protection, designed for across-the-line or star delta starting. Furnish with starter. Compressor motor power factor shall be .90 or greater. If the compressor motor power factor is less than .90, power factor correction capacitors must be installed.

F. Provide crankcase heater to evaporate refrigerant returning to crankcase during shut down. Energize heater when compressor is not operating.

2.4 EVAPORATOR

A. Provide shell and tube type evaporator, seamless or welded steel construction with cast iron or fabricated steel heads, seamless internally finned copper tubes, roller expanded into tube sheets.

B. Design, test, and stamp refrigerant side for 300 psig (2068 kPa) working pressure and water side for 215 psig (1482 kPa) working pressure, in accordance with ANSI/ASME SEC 8.

C. Insulate with 0.75-inch (20 mm) minimum thick flexible elastomeric rubber closed cell insulation with maximum K value of 0.26. Provide heat tape to protect evaporator to -20 degrees F (-29 degrees C).

D. Provide water drain connection, vent and fittings for factory installed leaving water temperature control and low temperature cutout sensors.

E. Evaporator shall have only one entering and one leaving connection. If manufacturer provides 2 separate evaporators, contractor shall provide manifold and pressure gauges to ensure equal flow is provided to each evaporator.

2.5 CONDENSER AND FANS

A. Construct condenser coils of corrosion protecting vinyl bonded aluminum fins (“Blue-Fin” coil protection) or copper fins mechanically bonded to seamless copper tubing. Provide sub-cooling circuits. Air test under water to 506 psig (3488 kPa).

B. Provide vertical discharge direct driven propeller type condenser fans with fan guard on discharge. Entire fan assembly shall be statically and dynamically balanced and fan assembly shall be either painted or zinc coated steel. Fan guard shall be either PVC, chrome or zinc coated.

C. Provide factory-mounted louvered, painted steel “architecturally pleasing” guard panels. Panel louvers shall cover condenser, evaporator and compressor sections so all are hidden from sight. Wire screens or wire mesh will not be allowed.

2.6 ENCLOSURES

A. House components in 12-gauge galvanized steel frame and mounted on welded structural steel base. Hot-dip galvanized steel frame coating shall be Underwriters Laboratories Inc. UL recognized as G90-U, UL guide number DTHW2.

B. Unit panels and control panels shall be finished with a baked on powder paint. Control panel doors shall have door stays. Paint system shall meet the requirements for outdoor equipment of Federal Government Agencies.

C. Mount starters and circuit breaker for high AIC rating in weatherproof panel provided with full opening access doors. Provide lockable disconnect operating handle external to panel and clearly visible from outside of unit indicating if power is on or off.

D. Casings fabricated from steel that do not have a zinc coating conforming to ASTM A 123 or ASTM A525 shall be treated for the prevention of corrosion with a factory coating or paint system. The coating or paint system shall withstand 500 hours in a salt-spray fog test in accordance with ASTM B 117. Each specimen shall have a standard scribe mark as defined in ASTM D 1654. Upon completion of exposure, the coating or paint system shall be evaluated and rated in accordance with procedures A and B of ASTM D 1654. The rating of failure at the scribe mark shall be not less than six (average creepage not greater than 1/8 inch). The rating of the unscribed area shall not be less than ten (no failure). Thickness of coating or paint system on the actual equipment shall be identical to that on the test specimens with respect to materials, conditions of application, and dry-film thickness.

2.7 REFRIGERANT CIRCUIT

A. All units 40 tons and larger shall have 2 refrigeration circuits, each with one, two, or three compressors per circuit.

B. Provide for each refrigerant circuit:

1. Liquid line shutoff valve.
2. Filter dryer (replaceable core type).
3. Liquid line sight glass and moisture indicator.
4. Electronic or thermal expansion valve sized for maximum operating pressure.
5. Charging valve.
6. Discharge and oil line check valves.
7. Compressor suction and discharge service valves.
8. High side pressure relief valve.
9. Full operating charge of R-410a and oil.
10. Unit factory leak tested at 200 psig.

C. Capacity Modulation: Unit shall be capable of operation down to 10%. In the event a manufacturer cannot provide unit with modulation down to 10%. Hot Gas Bypass must be provided.

2.8 SOUND POWER LEVELS

A. Provide low-sound fans, if required, to meet the following criteria.

B. Unit shall have a sound power rating of XX dBA maximum when tested in accordance with ARI Standard 370.

C. Unit shall have a sound pressure rating of 73 dBA maximum at 30 feet from unit. No reduction of sound levels by obstructions on sit is allowed in determining ratings.

2.9 STARTER AND CONTROLS CABINET

A. On chiller, mount weatherproof control panel, containing starters, power and control wiring, **fused disconnect switch, UL approved with external lockable operator handle or Main circuit breaker with AIC rating per electrical one-line in compliance with NEC**. Provide single point power connection. Provide primary and secondary fused control power transformer and a single 115-Volt single phase connection for controls and evaporator heat tape.

B. For each motor, provide wye-delta closed transition starter on 460V applications.

C. Provide the following safety controls with indicating lights or diagnostic readouts.

1. Low chilled water temperature protection.
2. High refrigerant pressure.
3. Low oil flow protection.
4. Loss of chilled water flow.
5. Contact for remote emergency shut-down.
6. Loss of refrigerant charge protection.
7. Motor current overload.
8. Phase reversal/unbalance/single phasing.
9. Over/under voltage.
10. Failure of water temperature sensor used by controller.
11. Compressor status (on or off).

D. Provide the following operating controls:

1. Eight (8) or more step leaving chilled water temperature controller which cycles compressors and activates cylinder unloaders or slide valve based on PI algorithms. If manufacturer is unable to provide at least 8 steps of unloading, providing hot gas bypass shall be required.
2. Five minute solid state anti-recycle timer to prevent compressor from short cycling. If a greater than 5 minute solid state anti recycle timer is provided, hot gas bypass shall be provided to insure accurate temperature control in light load applications.
3. Load limit thermostat to limit compressor loading on high return water temperature to prevent nuisance tripouts.
4. Low ambient controls for operation down to 0degrees F or lower.
5. High ambient unloader pressure stat that unloads compressors to keep head pressure under control and help prevent high pressure nuisance tripouts on days when outside ambient is above design.

6. Compressor current sensing unloader unit that unloads compressors to help prevent current overload nuisance tripouts.
7. Auto lead-lag functions that constantly evens out running hours and compressor starts automatically. If contractor cannot provide this function then cycle counter and hour meter shall be provided for each compressor so owner can be instructed by the contractor on how to manually change lead-lag on compressors and even out compressor starts and running hours.
8. Low ambient lockout control with adjustable setpoint.
9. Condenser fan sequencing which automatically cycles fans in response to ambient, condensing pressure and expansion valve pressure differential thereby optimizing unit efficiency.

E. Provide pre-piped gauge board with pressure gauges for suction and discharge refrigerant pressures or digital display of pressures on microprocessor.

F. Provide ammeters for each compressor or digital display of % RLA on microprocessor.

G. Provide remote mounted alarm and display panel with a minimum of the following features.

1. Leaving chiller water temperature setpoint adjustment.
2. Display diagnostics in 2.9 C.
3. Display entering and leaving water temperatures.
4. Display active chilled water and current limit setpoint.
5. Display ambient temperature.
6. Display parts failures:

    a. Water temperature and ambient temperature sensors.
    b. Motor contactors.
    c. Unit Controller.
    d. Condenser and evaporator refrigerant temperature sensors.

2.10 BUILDING MANAGEMENT SYSTEM

A. Provide communication interface utilizing a single twisted wire pair link to The Building Automation System. All Information available at the chiller, operating codes, monitoring information, setpoint adjustments, chiller sequencing and diagnostic shall be available at BMS display.

B. Provide 4-20 mA control signal from building automation system for leaving water temperature and demand limiting setpoint adjustment.

2.11 MISCELLANEOUS FEATURES

A. Provide low ambient lockout with adjustable outdoor air ambient temperature set point. Factory supply outdoor air thermostat for field installation.

B. Provide spring isolators and flow switch for field installation.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Align chiller package on steel or concrete foundations.

C. Install units on vibration isolators.

D. Connect to electrical service.

E. Connect to chilled water piping.

F. Arrange piping for easy dismantling to permit tube cleaning.

G. Coordinate all required electrical connections with electrical contractor including:

1. Single-point chiller connection
2. 120v heat tape connection

3.2 MANUFACTURER'S FIELD SERVICES

A. Supply service of factory trained representative for a period of 5 days to supervise testing, start-up, and instruction on operation and maintenance to Owner.

B. Supply initial charge of refrigerant and oil.

END OF SECTION

SECTION 23 73 13 - AIR HANDLING UNITS WITH COIL

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Modular Air Handling Units.

1.2 RELATED WORK

A. Section 23 05 13 - Motors and Starters
Section 23 05 30 - Electronic Speed Controllers
Section 23 09 00 - Automatic Temperature Controls
Section 23 40 00 - Air Cleaning
Section 23 82 16 - Air Coils

1.3 REFERENCES

A. ARI 430 - Standard for Central Station Air Handling Units.

B. NFPA 90A - Installation of Air Conditioning and Ventilation Systems.

C. ANSI/AFBMA 9 - Load Ratings and Fatigue Life for Ball Bearings.

D. SMACNA - HVAC Duct Construction Standards.

E. ARI 410 - Standard for Forced Circulation Air-Cooling and Air-Heating Coils.

F. ANSI/UL 900 - Test Performance of Air Filter Units.

G. AMCA 301 - Method for Publishing Sound Ratings for Air Moving Devices.

1.4 QUALITY ASSURANCE

A. Air Handling Units: Product of manufacturer regularly engaged in production of components who issues complete catalog data on total product offering.

B. Air Handling Units: Certify capacity, static pressure, fan speed, brake horsepower and selection procedures in accordance with ARI 430-89.

C. Air Coils: Certify capacities, pressure drops and selection procedures in accordance with ARI 410-87.

D. Airflow monitoring station: Certify airflow measurement station performance in accordance with AMCA 611.

1.5 SUBMITTALS

A. Submit as-built drawings and product data under provisions of Division 1.

B. As-built drawings shall show unit configuration in direction of airflow, and shall indicate assembly and unit dimensions.

C. Product data shall indicate dimensions, weights, capacities, fan performance, motor electrical characteristics, and finishes of materials.

D. Submit product data of filter sizes and quantities, filter performance, and filter frames.

E. Submit manufacturer’s installation instructions under provisions of Division 1.

F. Provide fan curves with specified operating point clearly plotted.

G. Submit sound power levels for air handling unit(s) at scheduled conditions. If unit exceeds sound power levels at scheduled conditions, manufacturer must provide sound attenuators.

1.6 OPERATION AND MAINTENANCE DATA

A. Submit operation and maintenance data under provisions of Division 1.

B. Include instructions for lubrication, filter replacement, motor and drive replacement, spare parts lists, and wiring diagrams.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Comply with manufacturer's installation instructions for rigging, unloading, and transporting units.

B. Units shall ship fully assembled up to practical shipping and rigging limitations. Units not shipped fully assembled shall have tags and airflow arrows on each section to indicate location and orientation in direction of airflow. Shipping splits shall be clearly defined on submittal drawings. Cost associated with non-conformance to shop drawings shall be the responsibility of the manufacturer. Each section shall have lifting lugs for field rigging, lifting and final placement of AHU section(s). AHU's less than 100-inches wide shall allow for forklift transport and maneuverability on the jobsite.

C. Deliver units to jobsite with fan motor(s), sheave(s), and belt(s) completely assembled and mounted in units.

D. Installing contractor shall be responsible for storing AHU in a clean, dry place and protect from weather and construction traffic. Handle carefully to avoid damage to components, enclosures, and finish.

1.8 START-UP AND OPERATING REQUIREMENTS

A. Do not operate units for any purpose, temporary or permanent, until ductwork is clean, filters in place, bearings lubricated (if applicable), condensate properly trapped, piping connections verified and leak-tested, belts aligned and tensioned, all shipping braces removed, bearing set screws torqued, and fan has been test run under observation.

1.9 WARRANTY

A. AHU manufacturer shall provide, at no additional cost, a standard parts warranty that covers a period of one year from unit start-up or 18 months from shipment, whichever occurs first. This warrants that all products are free from defects in material and workmanship and shall meet the capacities and ratings set forth in the equipment manufacturer's catalog and bulletins.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers:

1. Carrier
2. CES Group
3. Daikin McQuay Vision Plus
4. Scott Springfield
5. Titus
6. Trane Performance Climate Changer
7. York Solution

2.2 GENERAL

A. Any exceptions to the specifications must be clearly defined. The contractor shall be responsible for any additional expenses that may occur due to any exception made.

B. Factory fabricate draw-thru type air handling units suitable for the scheduled air pressure operation.

C. Factory fabricate units with fan section, coil sections, mixing box, filter sections, access sections, as called for on the drawings and in accordance with this specification.

D. Factory fabricate and test air handling units of sizes, capacities, and configuration as indicated and specified. Units shall be fully assembled up to practical shipping limitations. On units not shipped fully assembled, manufacturer shall tag each section to indicate location in direction of airflow to facilitate assembly at the job site.

2.3 UNIT CASING

A. Unit manufacturer shall ship unit in segments as specified by the contractor for ease of installation in tight spaces. The entire air handler shall be constructed of galvanized steel. Casing finished to meet ASTM B117 250-hour salt-spray test. The removal of access panels or access doors shall not affect the structural integrity of the unit. All removable panels shall be gasketed. All doors shall have gasketing around full perimeter to prevent air leakage. Contractor shall be responsible to provide connection flanges and all other framework that is needed to properly support the unit.

B. Casing performance - Casing air leakage shall not exceed leak class 6 (CL = 6) per ASHRAE 111 at specified casing pressure, where maximum casing leakage (cfm/100 ft2 of casing surface area) = CL X P0.65.

C. Air leakage shall be determined at 1.00 times maximum casing static pressure up to 8-inches w.g. Specified air leakage shall be accomplished without the use of caulk. Total estimated air leakage shall be reported for each unit in CFM, as a percentage of supply air, and as an ASHRAE 111 Leakage Class.

D. Under 55F supply air temperature and design conditions on the exterior of the unit of 81F dry bulb and 73F wet bulb, condensation shall not form on the casing exterior. The AHU manufacturer shall provide tested casing thermal performance for the scheduled supply air temperature plotted on a psychrometric chart. The design condition on the exterior of the unit shall also be plotted on the chart. If tested casing thermal data is not available, AHU manufacturer shall provide, in writing to the Engineer and Owner, a guarantee against condensation forming on the unit exterior at the stated design conditions above. The guarantee shall note that the AHU manufacturer will cover all expenses associated with modifying units in the field should external condensate form on them. In lieu of AHU manufacturer providing a written guarantee, the installing contractor must provide additional external insulation on AHU to prevent condensation.

E. Unit casing (wall/floor/roof panels and doors) shall be able to withstand up to 1.5 times design static pressure, or 8-inch w.g., whichever is less, and shall not exceed 0.0042 per inch of panel span (L/240).

F. Floor panels shall be double-wall construction and designed to support a 250-lb load during maintenance activities and shall deflect no more than 0.0042 per inch of panel span.

G. Unit casing panels shall be 2-inch double-wall construction, with solid galvanized exterior and solid galvanized interior, to facilitate cleaning of unit interior.

H. Unit casing panels (roof, walls, floor) and doors shall be provided with a minimum thermal resistance (R-value) of 13 Hr*Ft2*°F/BTU.

I. Unit casing panels (roof, walls, floor) and external structural frame members shall be completely insulated filling the entire panel cavity in all directions so that no voids exist. Panel insulation shall comply with NFPA 90A.

J. Casing panel inner liners must not extend to the exterior of the unit or contact the exterior frame. A mid-span, no-through-metal, internal thermal break shall be provided for all unit casing panels.

K. Access panels and/or access doors shall be provided in all sections to allow easy access to drain pan, coil(s), motor, drive components and bearings for cleaning, inspection, and maintenance.

L. Access panels and doors shall be fully removable without the use of specialized tools to allow complete access of interior surfaces.

a. supply and return duct installation prior to unit placement. Roof curb shall be shipped loose for field installation prior to unit placement.

2.4 ACCESS DOORS

A. Access doors shall be 2-inch double-wall construction. Interior and exterior shall be of the same construction as the interior and exterior wall panels.

B. All doors downstream of the cooling coil shall be provided with a thermal break construction of door panel and door frame.

C. Gasketing shall be provided around the full perimeter of the doors to prevent air leakage.

D. Door hardware shall be surface mounted to prevent through-cabinet penetrations that could likely weaken the casing leakage and thermal performance.

E. Handle hardware shall be designed to prevent unintended closure.

F. Access doors shall be hinged and removable without the use of specialized tools to allow.

G. Hinges shall be interchangeable with the door handle hardware to allow for alternating door swing in the field to minimize access interference due to unforeseen job site obstructions.

H. Door handle hardware shall be adjustable and visually indicate locking position of door latch external to the section.

I. All doors shall be a 60-inch high when sufficient unit height is available, or the maximum height allowed by the unit height.

J. Multiple door handles shall be provided for each latching point of the door necessary to maintain the specified air leakage integrity of the unit.

K. Where doors are taller than 8-feet provide interconnected handles allowing unit access without use of a ladder.

2.5 PRIMARY DRAIN PANS

A. All cooling coil sections shall be provided with an insulated, double-wall, galvanized drain pan.

B. The drain pan shall be designed in accordance with ASHRAE 62.1 being of sufficient size to collect all condensation produced from the coil and sloped in two planes, pitched toward drain connections, promoting positive drainage to eliminate stagnant water conditions when unit is installed level and trapped per manufacturer's requirements. See section 2.07, paragraph F through H for specifications on intermediate drain pans between cooling coils.

C. The outlet shall be located at the lowest point of the pan and shall be sufficient diameter to preclude drain pan overflow under any normally expected operating condition.

D. All drain pan threaded connections shall be visible external to the unit. Threaded connections under the unit floor shall not be accepted.

E. Drain connections shall be of the same material as the primary drain pan and shall extend a minimum 2-1/2 inch beyond the base to ensure adequate room for field piping of condensate traps.

F. The installing contractor is responsible to ensure the unit is installed level, trapped in accordance with the manufacturer's requirements, and visually inspected to ensure proper drainage of condensate.

G. Coil support members inside the drain pan shall be of the same material as the drain pan and coil casing.

H. If drain pans are required for heating coils, access sections, or mixing sections they will be indicated in the plans.

2.6 FANS

A. The fan type shall be provided as required for stable operation and optimum energy efficiency. The fan shall be statically and dynamically balanced at the factory as a complete fan assembly (fan wheel, motor, drive, and belts). The fan shaft shall not exceed 75 percent of its first critical speed at any cataloged speed. Fan wheels shall be keyed to the fan shaft to prevent slipping. The fan shafts shall be solid steel. The fan section shall be provided with an access door on the drive side of the fan.

B. Fan arrays to be provided with a VFD per fan wired to each motor in conduit. Drives to be factory installed in casing with a single disconnect.

C. Forward Curved Fan

1. The fan shall be a double-width, double-inlet, multi-blade-type, forward-curved (FC) fan. The fan shall be equipped with self-aligning, antifriction bearings with an L-50 life of 200,000 hours as calculated per ANSI/AFBMA Standard 9. Fan performance shall be certified as complying with AHRI Standard 430.

D. Backward Curved Fan

1. The fan shall be a double-width, double-inlet, multi-blade-type backward-curved (BC) fan. The fan shall be equipped with self-aligning, antifriction bearings with an L-50 life of200,000 hours as calculated per ANSI/AFBMA Standard 9. Fan performance shall be certified as complying with AHRI Standard 430.

E. Airfoil Fan

1. The fan shall be a double-width, double-inlet, multi-blade-type, airfoil (AF) fan. The fan shall be equipped with self-aligning, antifriction bearings with an L-50 life of 200,000 hours, as calculated per ANSI/AFBMA Standard 9. Fan performance shall be certified as complying with AHRI Standard 430.

F. Belt-Drive Plenum Fan

1. The fan shall be a single-width, single-inlet, multi-blade-type, plenum fan. The fan blades shall be backward-inclined airfoil. Belt-drive plenum fans shall be equipped with self-aligning, antifriction, pillow-block bearings with an L-50 life of 200,000 hours as calculated per ANSI/AFBMA Standard 9.

G. Direct-Drive Plenum Fan

1. The fan shall be a single-width, single-inlet plenum fan. The fan blades shall be aluminum backward-inclined airfoil. Plenum fan shall be direct-driven. Fan sections containing multiple fans shall be controlled using a common control signal, such as the duct static control signal, to modulate the fan speed.

2.7 FAN ISOLATION

A. One-Inch, Seismic Spring Isolators

1. The fan and motor assembly (on sizes 3 to8) shall be internally isolated from the unit casing with 1-inch (25.3-mm) deflection spring isolators, furnished and installed by the unit manufacturer. The isolation system shall be designed to resist loads produced by external forces, such as earthquakes, and conform to the current IBC seismic requirements.

B. Two-Inch, Seismic Spring Isolator

1. The fan and motor assembly (on sizes 10 to120) shall be internally isolated from the unit casing with 2-inch (50.8-mm) deflection spring isolators, furnished and installed by the unit manufacturer. The isolation system shall be designed to resist loads produced by external forces, such as earthquakes, and conform to the current IBC seismic requirements.

2.8 MOTORS AND DRIVES

A. All motors and drives shall be factory-installed and run tested. All motors shall be installed on a slide base to permit adjustment of belt tension. Slide base shall be designed to accept all motor sizes offered by the air-handler manufacturer for that fan size to allow a motor change in the future, should airflow requirements change. Fan sections without factory-installed motors shall have motors field installed by the contractor. The contractor shall be responsible for all costs associated with installation of motor and drive, alignment of sheaves and belts, run testing of the motor, and balancing of the assembly.

B. Motors shall meet or exceed all NEMA Standards Publication MG 1 - 2006 requirements and comply with NEMA Premium efficiency levels when applicable. Motors shall comply with applicable requirements of NEC and shall be UL Listed.

C. Fan Motors shall be heavy duty, open drip-proof operable at 460-Volts, 60Hz, 3-phase. If applicable, motor efficiency shall meet or exceed NEMA Premium efficiencies.

D. Belt driven fans shall use 4-pole, 1800 rpm, motors, NEMA B design, with Class B insulation, capable to operate continuously at 104 deg. F (40 deg. C) without tripping overloads.

E. Direct driven fans shall use 2-pole (3600 rpm), 4-pole (1800 rpm) or 6-pole (1200 rpm) motors, NEMA Design B, with Class B insulation capable to operate continuously at 104 deg F (40 deg C) without tripping overloads.

F. Motors shall have a +/- 10 percent voltage utilization range to protect against voltage variation.

G. V-Belt Drive shall be fixed pitch rated at 1.5 times the motor nameplate. Drives 20 hp and larger or any drives on units equipped with VFDs shall be fixed pitch.

H. Manufacturer shall provide for each fan a nameplate with the following information to assist air balance contractor in startup and service personnel in maintenance:

1. Fan and motor sheave part number
2. Fan and motor bushing part number
3. Number of belts and belt part numbers
4. Fan design RPM and motor HP

5. Belt tension and deflection
6. Center distance between shafts

I. Motor horsepowers shall not be changed without written approval from the Engineer.

2.9 COILS

A. Coils shall be manufactured by the same company of the supplier of the air handling unit. Coils shall be designed with aluminum plate fins and copper tubes.

B. Coils section header end panel shall be removable to allow for removal and replacement of coils without impacting the structural integrity of the unit.

C. Install coils such that headers and return bends are enclosed by unit casing to ensure that if condensate forms on the header or return bends, it is captured by the drain pan under the coil.

D. Coils shall be manufactured with plate fins to minimize water carryover and maximize airside thermal efficiency. Fin tube holes shall have drawn and belled collars to maintain consistent fin spacing to ensure performance and air pressure drop across the coil as scheduled. Tubes shall be mechanically expanded and bonded to fin collars for maximum thermal conductivity. Use of soldering or tinning during the fin-to-tube bonding process is not acceptable due to the inherent thermal stress and possible loss of bonding at that joint.

E. Construct coil casings of galvanized steel. End supports and tube sheets shall have belled tube holes to minimize wear of the tube wall during thermal expansion and contraction of the tube.

F. All coils shall be completely cleaned prior to installation into the air handling unit. Complete fin bundle in direction of airflow shall be degreased and steam cleaned to remove any lubricants used in the manufacturing of the fins, or dirt that may have accumulated, in order to minimize the chance for water carryover.

G. When two or more cooling coils are stacked in the unit, an intermediate drain pan shall be installed between each coil. The intermediate drain pan shall be designed being of sufficient size to collect all condensation produced from the coil and sloped to promote positive drainage to eliminate stagnant water conditions. The intermediate drain pan shall be constructed of the same material as the sections primary drain pan.

H. The intermediate drain pan shall begin at the leading face of the water-producing device and be of sufficient length extending downstream to prevent condensate from passing through the air stream of the lower coil.

I. Intermediate drain pan shall include downspouts to direct condensate to the primary drain pan. The intermediate drain pan outlet shall be located at the lowest point of the pan and shall be sufficient diameter to preclude drain pan overflow under any normally expected operating condition.

J. Provide factory installed extended drain and vent connections for water coils.

2.10 FILTERS

A. Provide factory fabricated filter section of the same construction and finish as unit casing with filter guides and hinged, removable double wall access doors with automotive style gasket form minimum leakage for filter removal. Filter boxes shall be fabricated to flange to other unit

components. Block offs shall be provided by the unit manufacturer as required to prevent air bypass around filters.

B. Filter type, MERV rating, and arrangement shall be provided as defined in project plans and schedule.

C. Manufacturer shall provide one set of startup filters.

2.11 DAMPERS

A. All dampers, with the exception of external bypass and multizones (if scheduled), shall be internally mounted. Dampers shall be premium ultra-low leak and located as indicated on the schedule and plans. Blade arrangement (parallel or opposed) shall be provided as indicated on the schedule and drawings. Dampers shall be Ruskin CD60 double-skin airfoil design or equivalent for minimal air leakage and pressure drop. Leakage rate shall not exceed 4 CFM/square foot at one-inch water gauge complying with ASHRAE 90.1 maximum damper leakage and shall be AMCA licensed for Class 1A. All leakage testing and pressure ratings shall be based on AMCA Standard 500-D. Manufacturer shall submit brand and model of damper(s) being furnished, if not Ruskin CD60.

2.12 ACCESS SECTIONS

A. Access sections shall be provided where indicated in the schedule and plans to allow additional access for inspection, cleaning, and maintenance of unit components. The unit shall be installed for proper access. Procedure for proper access, inspection and cleaning of the unit shall be provided in the AHU manufacturer's maintenance manual. Access section doors shall be constructed per Section 2.4.

2.13 DISCHARGE PLENUM SECTIONS

A. Plenums shall be provided as indicated in the schedule and plans to efficiently turn air and provide acoustical attenuation. Discharge plenum opening types and sizes shall be scaled to meet pressure drop requirements scheduled and align with duct takeoffs.

B. Discharge plenum panels shall include an acoustical liner where indicated in the schedule and plans to meet acoustical requirements. The liner shall be fabricated from stainless-steel perforated material to prevent corrosion and designed to completely encapsulate fiberglass insulation. The perforation spacing and hole size shall be such as to prevent insulation breakaway, flake off, or delamination when tested at 9000 fpm, in accordance with UL 181 or ASTM C1071. Insulation material must be resistant to fungi in accordance with ASTM C1338.

2.14 MARINE LIGHTS

A. Marine lights shall be provided throughout AHUs as indicated on the schedule and plans. Lights shall be instant-on, light-emitting diode (LED) type to minimize amperage draw and shall produce lumens equivalent to a minimum 75W incandescent bulb (1200 lumens). LED lighting shall provide instant-on, white light and have a minimum 50,000 hr life.

B. Light fixture shall be weather-resistant, enclosed and gasketed to prevent water and dust intrusion.

C. Fixtures shall be designed for flexible positioning during maintenance and service activities for best possible location providing full light on work surface of interest and not being blocked by technician.

D. All lights on a unit shall be wired in the factory to a single on-off switch.

E. Installing contractor shall be responsible for providing 115V supply to the factory-mounted marine light circuit (unless single-point power is specified to be provided by AHU manufacturer).

2.15 CONVENIENCE OUTLETS

A. A 15-amp, 115V GFCI convenience outlet shall be provided by the AHU manufacturer. The outlet shall be separate from the load side of the equipment per NEC requirements. Installing contractor shall be responsible for providing 115V supply to the factory-mounted GFCI outlet circuit per NEC (even when single-point power is specified to be provided by AHU manufacturer).

2.16 FACTORY WIRING

A. VFDs shall be wired per NEC, UL, and NFPA 90A requirements. Units with factory-mounted controls shall also include power wiring from the VFD or starter/disconnect control transformer to the control system transformers. Units with VFDs and factory-mounted controls shall have a binary start-stop signal and an analog speed signal wired from the direct digital controller to the VFD.

B. All power wiring for voltages greater than 24V and traveling through multiple unit sections shall be contained in an enclosed, metal, power-wiring raceway or EMT. Sections less than 6 inch in length may be contained in FMC.

C. After mounting and wiring of VFDs, on the AHUs, trained factory personnel shall ensure proper operation of each VFD, through a thorough factory test. Testing shall include a Hypot test of unit wiring to ensure that no weaknesses exist in wiring or motor. Each VFD shall be energized and the fan run to ensure the VFD will operate throughout the usable range of the drive and that the fan rotation is correct. Each VFD with bypass shall also be tested in the bypass position to ensure the bypass is operational.

D. For fan motors not supplied with a factory-mounted and wired starter or VFD, the unit manufacturer shall supply a 4 X 4 NEMA 4 junction box on the exterior of the fan section(s) with wiring, prewired to the fan motor, to allow for ease of field installation of a starter or VFD.

E. On units provided with factory-mounted and wired supply fan starter or VFD and DDC controls, the manufacturer shall provide a single point of power. Line-to-24v transformers shall be provided with sufficient vA to power the unit-mounted controller and factory installed control points.

2.17 VARIABLE FREQUENCY DRIVES (VFDS)

A. Variable frequency drives shall be provided, mounted and wired by the AHU manufacturer as indicated on the schedule and drawings. All standard and optional features shall be included within the VFD enclosure, unless otherwise specified. The VFDs shall be UL listed. The listing shall allow mounting in plenum or other air handling compartments.

B. Refer to Section 23 05 30 for further requirements.

2.18 ENERGY RECOVERY WHEEL SECTION

A. The air-handling unit shall have a total energy recovery wheel sized per the ventilation requirement of the unit. Mixed air units with economizing shall be constructed with internal bypass dampers such that the pressure drop across the wheel does not increase during economizing.

B. Performance and Certification

1. The energy recovery wheel shall be ARI 1060-certified. The air-handling unit nameplate shall bear the ARI 1060 certification label. The energy recovery cassette shall be an underwriter's laboratories (UL) recognized component certified for mechanical, electrical, and fire safety in accordance with UL standard 1812. The calculated total net effectiveness of the recovery device shall be not less than 70 percent when the specified ventilation flow rate equals the exhaust flow rate.

C. Wheel Construction

1. The energy recovery wheel cassette shall incorporate a rotary wheel with all necessary seals, drive motor, and drive belts. The total energy recovery wheel shall incorporate a desiccant without the use of binders or adhesives. Coated segments shall be washable using standard detergent or alkaline-based coil cleaners. The desiccant shall not dissolve in the presence of water or high humidity. The rim shall be of continuous rolled stainless steel and forms an even concentric circle, preventing leakage around the rim and minimizing the wear of components. All diameter and perimeter seals shall be provided as part of the cassette assembly. Perimeter seals shall be self-adjusting; diameter seals are adjustable. Seals shall be factory set. Wheel bearings shall be permanently sealed and lubricated and have a minimum l-10 life of 400,000 hours.

D. Wheel Motor

1. The wheel drive motor shall be mounted in the cassette frame. The wheel drive motor shall be thermally protected, and UL component recognized. Drive belts shall not require belt tensioners.

E. Maintenance and Access

1. Energy recovery wheel shall be provided in the form of removable segments. The segments shall be removable without the use of tools to facilitate maintenance and cleaning as required. The cassette shall be removable through the energy recovery section side panel. Access doors shall be provided immediately upstream and downstream of the energy recovery wheel cassette. Adequate space shall be provided for cleaning, service, and maintenance of the wheel, motor, bearing, and belt.

F. Wheel Control

1. The energy recovery wheel section shall incorporate a variable effectiveness damper to control the energy wheel recovery capacity. The variable effectiveness control shall have the ability to modulate the total energy recovery effectiveness to 40 percent of the initial total recovery capacity. Variable frequency speed control is not an acceptable method for controlling capacity.

G. Frost Control

1. Frost control prevention shall be achieved by either outside air bypass, or return air preheat. Frost setpoint temperatures based on scheduled design air conditions shall be provided by the air handling manufacturer. Winter design supply and exhaust air conditions leaving the energy wheel provided by the unit manufacturer shall include any de-rate in performance due to frost protection measures.

H. Wheel Warranty

1. In conjunction with the air handler manufacturer ‘s standard unit warranty, the energy recovery wheel shall be warranted for a period of five years. Warranty applies to all parts and components of the energy recovery cassette with the exception of the motor.

PART 3 - EXECUTION

3.1 GENERAL

A. Assemble and install in accordance with manufacturers written installation instructions and details on drawings.

B. Coordinate duct, piping and electrical work so as to provide access to unit for maintenance and filter replacement and coil removal with minimum disturbance of piping.

C. Prior to unit start-up all controls shall be installed and tested.

D. Prior to initial start-up and for system testing install air filters to protect the unit and ductwork from dirt and debris. After the system has been tested and prior to turning the system over to the Owner, replace the pre-filters with new, clean filters as specified.

E. Prior to turning the system over to the Owner, all damages incurred during shipping, storing and installing shall be repaired. These repairs shall be sufficient to bring the equipment back to the quality standards, equal to the original manufacturing standards. These repairs shall include but are not limited to repairing painted surfaces, dent removal, combing coil fins, repairing or replacing wet, sagging or torn insulation, etc.

F. Pipe condensate full size to nearest floor drain. Provide trap 1” greater than fan static pressure.

G. Install units with adequate clearances to access valves, open access doors fully, for coil pull and NEC clearances in front of disconnect switches.

END OF SECTION

SECTION 23 73 24 - SPLIT SYSTEM DX AIR HANDLING UNITS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Packaged Split System DX air handling units.

B. Refrigeration components.

1.2 RELATED SECTIONS

A. Section 23 05 13 – Motors

B. Section 23 40 00 – Air Cleaning

1.3 REFERENCES

A. ANSI/ASHRAE 15 - Safety Code for Mechanical Refrigeration.

B. ANSI/ASHRAE/IES 90.1A – 2001 - Energy Conservation in New Building Design Standard.

C. ARI 210/240 - Unitary Air-Conditioning Equipment and Air-Source Heat Pump Equipment, (less than 135,000 Btuh).

D. ARI 360 - Commercial and Industrial Unitary Air Conditioning Equipment testing and rating standard, (equipment greater than 135,000 Btuh).

E. ARI 340 - Commercial and Industrial Unitary Heat Pump Equipment, (heat pumps above 135,000 Btuh).

F. ANSI Z21.47/UL1995 - Unitary Air Conditioning Standard for safety requirements.

1.4 QUALITY ASSURANCE

A. Air Handling Units: Product of manufacturer regularly engaged in production of components who issues complete catalog data on total product.

1.5 SUBMITTALS

A. Submit unit performance data including capacity, nominal and operating performance.

B. Submit Mechanical Specifications for unit and accessories describing construction, components and options.

C. Submit shop drawings indicating overall dimensions as well as installation, operation and service clearances. Indicate lift points and recommendations and center of gravity. Indicate unit shipping, installation and operating weights including dimensions.

D. Submit data on electrical requirements and connection points. Include recommended wire and fuse sizes or MCA, sequence of operation, safety and start-up instructions.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Comply with manufacturer's installation instructions for rigging, unloading, and transporting units.

B. Store in clean dry place and protect from weather and construction traffic. Handle carefully to avoid damage to components, enclosures, and finish.

1.7 ENVIRONMENTAL REQUIREMENTS

A. Do not operate units for any purpose, temporary or permanent, until ductwork is clean, filters are in place, bearings lubricated, and fan has been test run under observation.

1.8 WARRANTY

A. Provide one year parts warranty.

PART 2 - PRODUCTS

2.1 SUMMARY

A. The contractor shall furnish and install air handling units(s) as shown as scheduled on the contract documents. The unit(s) shall be installed in accordance with this specification and perform at the specified conditions as scheduled.

B. Approved Manufacturers:

1. Daikin Applied
2. LG
3. Mitsubishi
4. Samsung

2.2 GENERAL

A. Provide indoor-mounted, draw-thru, packaged air handling unit(s). Unit(s) shall be factory-assembled including direct-expansion evaporator coil, expansion valve(s), check valves, condensate drain pan, centrifugal fan assembly with fan motor(s) and mounting bracket sheaves, drives and belts, filters, and electrical controls. Units shall be suitable for either horizontal or vertical airflow configuration and be used with or without ductwork.

2.3 CASING

A. Unit casing shall be constructed of zinc-coated, heavy-gauge, galvanized steel. Exterior surfaces shall be cleaned, phosphatized and finished with a baked enamel finish.

B. Unit casing shall be completely insulated with fire-retardant, permanent, foil-faced, odorless glass fiber material.

2.4 FANS

A. Provide fan section with forward curved, double width, double inlet, centrifugal type fan.

B. Provide self-aligning, grease lubricated, ball or roller bearings with permanent lubrication fittings.

C. Factory mount motor on slide rails. Provide access to motor, drive, and bearings through removable casing panels.

D. Provide shafts constructed of solid hot rolled steel, ground and polished, with key-way, and protectively coated with lubricating oil.

E. Provide cast iron or steel variable and adjustable pitched sheaves, dynamically balanced, bored to fit shafts and keyed.

2.5 COILS

A. Provide configured aluminum fin surface mechanically bonded to copper tubing coil. Enclose coils with headers and return bends fully contained within casing. Coil shall have factory installed expansion valves and factory pressure and leak tested at 375 psig.

B. Provide double sloped condensate drain pan constructed of PVC with external connections on either side of unit. The drain pan shall be removable for cleaning.

2.6 FILTERS

A. Provide one-inch-throwaway filters, factory installed. Provide access from side panel for removal. Filter rack shall be field convertible to two-inch capability with field provided two-inch-throwaway filters.

B. Provide two-inch-throwaway filters, factory installed. Units shall have filter access from either side panel.

2.7 CONTROLS

A. Provide factory installed and wired controls including fan contactor, low-voltage terminal strip and single point power entry.

B. Provide factory installed evaporator defrost control to prevent coil freezing at low evaporator temperatures.

2.8 MISCELLANEOUS FEATURES

A. Thermostats: Provide 24-Volt operation control, factory-supplied and field-installed. For specifications see air-cooled condensing unit, section 23 62 13.

B. Vibration Isolators: Provide spring floor-mounted isolators to reduce transmission of noise and vibration to building structures.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install unit on vibration isolators. Reference Section 23 05 48.

END OF SECTION

SECTION 23 81 23 - ELECTRONIC ROOM AIR CONDITIONING UNIT

PART 1 - GENERAL

1.1 FLAME-SMOKE RATINGS

A. Except as otherwise indicated, provide air-handling unit thermal insulation with flame-spread rating of 25 or less, fuel-contributed of 50 or less, and smoke-developed rating of 50 or less.

1.2 ARI CERTIFICATION

A. Provide equipment rated in accordance with ARI Standard 210, and bearing ARI certification label.

1.3 SUBMITTALS

A. Submit manufacturer’s data, including:

1. Capacity.
2. Drawings showing overall dimensions of complete assembly.
3. Operating weights.
4. Equipment support requirements.
5. Sizes and locations of connections.
6. Accessories.
7. Auxiliary support requirements.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Liebert

B. Schneider/APC

2.2 SPLIT SYSTEM AIR CONDITIONING UNIT

A. General:

1. The computer room environmental control units shall be self-contained, factory assembled.
2. Units shall meet UL standards, and shall be in compliance with NEC and local building department authorities.

3. Manufacturer to provide maintenance for entire computer room system for a period of (1) year from date of acceptance. This should include bi- monthly visits of 3.5 hours minimum to perform all preventative maintenance items as recommended by the equipment manufacturer, including replacement of filters, cleaning of humidifier, and parts as required. Manufacturer to provide 4 hours of training for the Owner's Representative, followed by an additional 2 hours of follow-up training within the first year.

2.3 INDOOR DX AIR CONDITIONING UNIT

A. Enclosure:

1. Material: Steel, zinc coated.
2. Finish:

    a. Baked enamel.
    b. Color selected by Owner from manufacturer's standard colors.

3. Insulation:

    a. Material: Fiberglass.
    b. Thickness: One inch.
    c. Protection: Mat or foil faced.

B. Filters:

1. Type: Throw-away, MERV8
2. Manufacturer and Model:

    a. AAF, Amair.
    b. Farr, 30/30.

3. Thickness: Four inch.

C. Evaporator Fan:

1. Type: Forward curve, centrifugal.
2. Drive: Adjustable V-belt.
3. Bearings: Self-aligning, 100,000 hour.
4. Balancing: Static and dynamic.

D. Humidifier:

1. Type: Infrared high intensity quartz lamps or ultrasonic.
2. Water Container: Stainless steel.
3. Capacity Control: Self-regulating.
4. Water Supply: Tap water.
5. Safety Control: Audible and visual alarm.

E. Reheat:

1. Type: Electric.
2. Construction: Fin tubular.
3. Safety Controls: Thermal safety switches.
4. Stages: Three, equal.

F. Compressors:

1. Type: Semi-hermetic.
2. Quantity: Two, each one-half total capacity.
3. Mounting: Vibration isolators.
4. Protection:

    a. Over-temperature.
    b. Over-current.
    c. High pressure.

G. Refrigeration System:

1. Each refrigeration circuit shall include hot gas mufflers, liquid line filter dryers, refrigerant sight glass with moisture indicator; adjustable, external equalized expansion valves, and liquid line solenoid valves.

H. Evaporator and Glycol Coil:

1. Material:

    a. Tubes: Copper.
    b. Fins: Aluminum.

2. Drain Pan: Stainless steel.

I. Condensers:

1. Type: Counter-flow.
2. Construction: Shell and tube, removable heads.
3. Certification: ASME, 400 psig at 300ºF maximum operating condition.

J. Controls:

1. Manufacturer’s standard, factory-wired.

K. Accessories:

1. Condensate Pump:

    a. Packaged unit.
    b. Automatic control.

2. Floor stand:

    a. Adjustable height.

3. Liqui-tect/Liqui-tector:

    a. Solid state water sensor and alarm. Two liqui-tect sensors.

4. Disconnect:

    a. Non-locking.

5. Four-year extended compressor warranty.

L. Control:

1. The control system shall allow programming of the following room conditions:

    a. Temperature Setpoint (65-85ºF).
    b. Temperature Sensitivity ±ºF in 0.1ºF increments).
    c. Humidity Setpoint (40-60% RH).
    d. Humidity Sensitivity (± 1 - ± 10% RH in 0.1% increments).
    e. All setpoints shall be adjustable from the individual unit front monitor panel or a site monitoring device.
    f. Temperature and Humidity Sensors shall be capable of being calibrated using the front monitor panel controls to coordinate with other temperature and humidity sensors in the room.
    g. The control system shall also be capable of predictive control of temperature and humidity.
    h. Temperature Anticipation. The microprocessor shall have the capability of responding to varying rates of temperature change in the computer room. The control system shall delay heating or cooling in response to rapid temperature changes.
    i. Predictive Humidity Control. The microprocessor shall calculate the moisture content in the room and prevent unnecessary humidification cycle by responding to changes in dewpoint temperature.

2. In addition, the system shall provide the following internal controls:

    a. Compressor Short Cycle Control.
    b. Automatic Compressor Sequencing. The microprocessor shall automatically change the lead/lag sequence of the compressors after each start to lengthen compressor-on cycles and even compressor wear.
    c. System Auto-Restart. For start-up after power failure, the system shall provide automatic restart with a programmable (up to 10 minutes) time delay.
    d. Sequential Load Activation during start-up, or after power failure, the microprocessor shall sequence operational load activation to minimize inrush current systems allowing multiple loads to start simultaneously are unacceptable.

3. Control Panels:

    a. The microprocessor shall provide a local monitor panel to display operation status alarms and permit calibration and programming of operation parameters. All indicators shall be in language form. No symbols or codes shall be acceptable.

b. Provide a lead/lag control to provide the following sequence of operation:

1) Lead AC unit operates according to unit's integral control system. Lead AC unit is selected by switch on panel face, indicator lights on panel face indicate which unit is in operation.
2) If lead unit should not be able to keep up with system demand and space temperature rises above setpoint (72ºF adjustable), lag unit will start automatically, unit failure alarm can be silenced by pressing the alarm silence switch on panel face. Both units will remain in operation until reset by pressing the system reset switch on panel face.
3) If lead or lag unit should fail, both units will start automatically, unit failure light on panel face will illuminate, and alarm will sound. Alarm can be silenced by pressing the alarm silence switch on panel face. System can be reset by pressing the system reset switch on panel face.

4. Alarms:

The microprocessor shall activate an audible and visual alarm in event of any of the following conditions:

a. High Temperature
b. Low Temperature
c. High Humidity
d. Low Humidity
e. High Compressor Head Pressure
f. Humidifier Problem
g. Loss of Air Flow
h. Audible Alarm. The audible alarm shall have adjustable volume to match the surrounding ambient sound level.
i. Common Alarm. A programmable common alarm shall be provided to interface selected alarms with the DDC System provided under Division 23 09 00.
j. The microprocessor shall provide the capability of maintaining a log of system performance and environmental conditions. The following information shall be included in the log, complete with time and date:

1) Temperature (present, minimum and maximum for last 24 hours).
2) Humidity (present, minimum and maximum for last 24 hours).
3) Compressor Operating Hours.
4) Alarm Occurrence.
5) Diagnostics. All electronic circuitry shall be provided with self-diagnostics in trouble shooting. Each printed circuit board shall be diagnosed reported as pass/not pass.
6) Communications. The microprocessor shall be compatible with all remote monitoring control devices. Provide the following equipment and accessories with the computer room environmental units. Accessories shall be factory installed and prewired for connection by the contractor.

- Under floor water sensor - activates visual alarm.
- 18" floorstand.

2.4 OUTDOOR CONDENSER

A. Housing:

1. Material: Aluminum.

B. Coils:

1. Material:

a. Tubes: Copper.
b. Fins: Aluminum.

C. Fans:

1. Type: Propeller.
2. Drive: Direct.
3. Air flow: Up discharge.

2.5 LEAK DETECTION SYSTEM

A. Manufacturers:

1. Design Basis: Liebert Liqui-tect
2. Other Acceptable Manufacturers:

a. Approved equal.

B. General:

1. Provide a leak detection system interlocked with the operation of the cooling unit. Unit to shut down upon alarm.
2. System to include a controller capable of monitoring all point, zone, and cable leak detection sensors. Controller to tie into all cooling units.
3. Count and type of sensors used to be field coordinated. Cable leak detectors to be used in all raised floor applications.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install units level and plumb.

B. Provide necessary auxiliary supporting steel.

3.2 ADJUSTMENTS

A. Adjust drive for speed shown in submittal.

B. Mount motors and drives so belts run true.

C. Check motor amps.

1. Do not overload motor.

D. Check for unusual noise or vibration and correct as necessary.

E. Provide necessary lubrication.

END OF SECTION

This page is intentionally left blank.

SECTION 23 81 26 - SPLIT SYSTEM AIR CONDITIONERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Refer to Division 01 and Section 230502, BASIC MECHANICAL REQUIREMENTS

1.2 SUMMARY

A. General: Provide split air conditioning system complete, as shown and specified per Contract Documents, including, but not limited to, the following:

1. Outdoor-mounted, air-cooled condensing unit.
2. Matching and corresponding indoor fan coil unit.
3. Refrigerant piping between indoor and outdoor units.
4. Control wiring between indoor and outdoor units.
5. Control.
6. Accessories.

B. Other Applicable Sections:

1. Applicable portions of Division 1 and Section 230502, BASIC MECHANICAL REQUIREMENTS and Section 230503, BASIC MECHANICAL MATERIALS AND METHODS, apply to the work of this Section.
2. Section 232113, HYDRONIC PIPING, Section 232300, REFRIGERANT PIPING and Section 230700, MECHANICAL INSULATION.

1.3 STANDARDS

A. Materials, equipment and installation shall comply with all applicable building laws and with published standards of:

1. ASHRAE
2. AMCA
3. ARI
4. U.L.
5. SMACNA

1.4 SUBMITTALS

A. Procedure: Refer to Division 1.

B. In addition to the requirements of Division 1 and of Section 23 05 02, BASIC MECHANICAL REQUIREMENTS, the submittal material shall include, but not be limited to, the following:

1. Descriptive Data:

a. Performance data.
b. Published sound power levels based on actual test data.
c. Finishes.
d. Piping arrangement.
e. Accessories.
f. Condensing unit and fan coil unit operating weights.

2. Shop Drawings:

a. Installation details.
b. Wiring diagrams.

1.5 QUALITY ASSURANCE

A. Product Options: Drawings indicate size, profiles, and dimensional requirements of split-system units and are based on the specific system indicated. Refer to Division 01 Section "Product Requirements."

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1-2004, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."

D. ASHRAE/IESNA 90.1-2004 Compliance: Applicable requirements in ASHRAE/IESNA 90.1-2004, Section 6 - "Heating, Ventilating, and Air-Conditioning."

1.6 COORDINATION

A. Coordinate size and location of concrete bases for units. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork are specified in Division 03 Section "Cast-in-Place Concrete."

B. Coordinate size, location, and connection details with roof curbs, equipment supports, and roof penetrations specified in Division 07 Section "Roof Accessories."

1.7 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of split-system air-conditioning units that fail in materials or workmanship within specified warranty period.

B. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURER

A. Carrier

B. Daikin Applied

C. JCI

D. Mitsubishi

E. Samsung

F. Sanyo

G. Trane

2.2 GENERAL

A. Manufacturers shall be responsible for examining application of each type of unit to assure that each will operate properly in the intended application.

B. Indoor and outdoor sections shall be of the same manufacturer.

C. Performance shall be as scheduled.

D. Combination of indoor and outdoor units shall be tested. “Approved Standard Ratings” shall be in accordance with Industry Standard 441-66.

2.3 OUTDOOR AIR-COOLED CONDENSING UNIT

A. General: Factory assembled, single piece, air-cooled condensing outdoor unit. Contained within the unit enclosure shall be all factory wiring, piping, controls, compressor(s), full charge of R410A refrigerant, and special features required prior to field start-up.

B. Unit Cabinet:

1. Unit cabinet shall be constructed of galvanized steel, bonderized and coated with a baked enamel finish.
2. Unit access panels shall be removable with minimal screws and shall provide full access to the compressor, fan, and control components.
3. Compressor compartment shall be isolated and have an acoustic lining to assure quiet operation.

C. Fans:

1. Condenser fans shall be direct-drive propeller type, shall discharge air horizontally or horizontally as indicated on drawing, and shall blow air through the condenser coil.

2. Condenser fan motors shall be totally enclosed, single phase motors with Class B insulation and permanently lubricated sleeve bearings. Motor shall be protected by internal thermal overload protection.
3. Shaft shall have inherent corrosion resistance.
4. Fan blades shall be corrosion resistant and shall be statically and dynamically balanced.
5. Condenser fan openings shall be equipped with PVC coated protection grille over fan and coil.

D. Compressor(s)

1. Compressor(s) shall be fully hermetic scroll type.
2. Compressors shall be equipped with oil system, operating oil charge, and motor internal overloads shall protect the compressors from over-temperature and overcurrent. Compressors shall also have high discharge gas temperature protection.
3. Motor shall be NEMA rated Class F, suitable for operation in a refrigerant atmosphere.
4. Compressor assembly shall be installed on rubber vibration isolators.
5. Compressors shall be single phase.

E. Condenser Coil: Coil shall be constructed of aluminum fins mechanically bonded to internally enhanced seamless copper tubes which are cleaned, dehydrated and sealed.

F. Refrigeration Components: Refrigerant circuit components shall include brass external vapor supply line service valve(s), vapor return line service valve(s) with service gauge connection port, service gauge port connections on compressor suction and discharge lines with Schrader-type fittings with brass caps, filter drier(s), pressure relief, liquid line solenoid valves, thermostatic expansion valves and a full charge of refrigerant.

G. Controls and Safeties: Operating controls and safeties shall be factory selected, assembled, and tested. Air Conditioning unit control shall be compatible and interfaced with the Building Control Systems, Section 230900, BUILDING AUTOMATION AND AUTOMATIC TEMPERATURE CONTROL SYSTEMS. The minimum control function shall include:

1. Controls:

a. Time delay restart to prevent compressor reverse rotation.
b. Automatic restart on power failure.
c. Safety lockout if any condensing unit safety is open.
d. A time delay control sequence through the fan coil board.
e. High and low pressure switches.
f. Automatic condenser fan motor protection.

2. Safeties:

a. High condensing temperature protection (when matched with Carrier Model 40MVC fan coils).
b. System diagnostics (when used with Carrier Model 40MVC fan coils).
c. Compressor motor current and temperature overload protection.
d. High pressure relief
e. Condenser fan failure protection.

H. Electrical Requirements

1. Unit shall operate on single phase, 60 cycle power at 208/230V as specified on contract drawings.

2. Unit electrical power shall be a single point connection.
3. Unit or control voltage to the indoor fan coil shall be 24V.
4. All power and control wiring shall be installed per NEC and all local Building Codes.
5. Unit shall have low-voltage terminal block connections.

I. Required Options:

1. Winter Start Control: Field installed winter start control shall permit start-up for cooling operation under low load conditions and at low ambient temperatures by bypassing the low pressure switch for a 3 minute delay period.
2. Low ambient controller shall be provided and installed on the unit.
3. Crankcase Heater: Field-installed crankcase heater shall be a clamp-on compressor oil sump heater. Heater shall be used in all applications where operation in cooling below 40°F outdoor ambient temperature is anticipated.

2.4 HIGH WALL FAN COIL UNIT

A. General: Indoor, direct-expansion, wall-mounted fan coil. Unit shall be complete with cooling coil, fan, fan motor, piping connectors, electrical controls, micro-processor control system, and integral temperature sensing. Unit shall be furnished with integral wall-mounting bracket, mounting hardware, thermistor interconnection cable, and condensate pump.

B. Cabinet: Cabinet discharge and inlet grilles shall be attractively styled, high-impact polystyrene. Cabinet shall be fully insulated for improved thermal and acoustic performance.

C. Fan Section: Fan shall be tangential direct-drive blower type with air intake at the upper front face of the unit and discharge at the bottom front. Automatic, motor-driven vertical air sweep shall be provided standard. Air sweep operation shall be user selectable. Horizontal direction may be manually adjusted (using remote controller) and vertical air sweep may be manually set.

D. Coil: Coil shall be copper tube with aluminum fins and galvanized steel tube sheets. Fins shall be bonded to the tubes by mechanical expansion. A drip pan under the coil shall have a drain connection for hose attachment to remove condensate. Condensate pan shall have internal trap and auxiliary drip pan under coil header.

E. Motor: Motors shall be open drip-proof, permanently lubricated ball bearing with inherent overload protection. Fan motors shall be 3-speed.

F. Filters: Unit shall have filter track with factory-supplied cleanable filters.

G. Controls: Controls shall consist of a microprocessor-based control system which shall control space temperature, determine optimum fan speed, and run self diagnostics. The temperature control range shall be from 64°F to 84°F.

H. Electrical Requirements: Unit shall operate on power supply as specified on the equipment schedule.

2.5 ACCESSORIES

A. Provide refrigerant piping filter/dryer and glass moisture indicator for Field Installation.

B. Provide system with “Long Refrigerant Line” package.

PART 3 - EXECUTION

3.1 GENERAL

A. Locate units as indicated on the Drawings. Contractor shall be responsible for verifying with the Owner's Representative if suitability is doubted and to notify the Owner's Representative before installation of any apparent improper installation.

3.2 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect , test, and adjust field-assembled components and equipment installation, including connections , and to assist in field testing. Report results in writing.

B. Perform the following field tests and inspections and prepare test reports:

1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Remove and replace malfunctioning units and retest as specified above.

3.3 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

B. Complete installation and startup checks according.

3.4 REFRIGERANT PIPING

A. Refrigerant Piping: Conform to Section 232113, HYDRONIC PIPING and Section 232300, REFRIGERANT PIPING.

B. Coordinate with equipment manufacturer and provide necessary traps in refrigerant pipe as required.

3.5 EQUIPMENT AND PIPE VIBRATION ISOLATION

A. Conform to Section 230548, VIBRATION CONTROLS

END OF SECTION

SECTION 23 81 29 - VARIABLE REFRIGERANT FLOW HVAC SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Bidders shall provide the minimum system as indicated on drawing, including Heat Recovery or Heat Pump systems as defined by model and family numbers. All systems shall be capable of providing the scheduled capacity at the location of the indoor unit regardless of pipe length. Nominal or catalog capacities will not be accepted.

B. Heat Recovery systems shall be capable of simultaneous cooling and heating.

C. Heat Recovery systems shall be capable of transferring heat between individual indoor units and between individual Mode Control Units.

D. Heat Recovery systems shall have a space temperature controller for each connected indoor unit. Each individual space temperature controller shall be capable of automatically satisfying heating or cooling regardless of time of day, occupancy, or season without inhibiting or affecting other space temperature controllers.

E. Heat pump systems that do not allow for simultaneous heating and cooling are not acceptable.

F. VRF System Controls, installation, and integration shall be provided by the manufacturer of the VRF system. Graphics shall include floor plan layout.

G. Systems that have a phase imbalance tolerance less than 10% shall be provided with a phase monitor and controls to protect the unit.

1.3 SUBMITTALS

A. Product data for each product.

B. Dimensional data for each product.

C. Manufacturer’s selection reports indicating design conditions, load profile, actual capacity, altitude corrections, and relative equipment locations.

D. Manufacturer’s piping and wiring layout indicating piping, wire sizes, equipment quantities, piping length estimates, and refrigerant charge.

E. Performance report for each product.

F. Control system wiring diagrams and network architecture.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For VRF HVAC systems to include in emergency, operation, and maintenance manuals. Service and installation manuals must be readily available on the manufacturer's website without entering a username and password.

B. Software and Firmware Operational Documentation:

1. Software operating and upgrade manuals.
2. Program Software Backup: On CD or DVD, USB media, or approved cloud storage platform, complete with data files.
3. Device address list.
4. Printout of software application and graphic screens.

1.5 QUALITY ASSURANCE

A. System efficiencies (SEER and HSPF) for units less than 65,000 BTUH shall be certified by AHRI standard 210-240 and shall be published for public review at www.ahrinet.org. Equipment that is "rated" in accordance with AHRI Standard 210-240, but not published for public review by AHRI shall not be accepted.

B. System efficiencies (IEER and SCHE) for units greater than 65,000 BTUH shall be certified by AHRI standard 1230 and shall be published for public review at www.ahrinet.org. Equipment that is "rated" in accordance with AHRI Standard 1230, but not published for public review by AHRI shall not be accepted.

C. The units shall be listed by Electrical Laboratories (ETL) and bear the ETL label.

D. All wiring shall be in accordance with the National Electrical Code (N.E.C.).

E. Project shall comply with the applicable version of ASHRAE standard 15.

F. Project shall comply with the applicable version of ASHRAE 90.1

G. The VRF manufacturing facility shall be registered to ISO 9001 and ISO14001.

H. All components shall be provided by one manufacturer including but not limited to:

1. Outdoor Units
2. Indoor Units
3. Mode Control Units as required
4. All necessary and applicable controls for the VRF System
5. Factory refrigerant charge for outdoor unit(s) only
6. Factory Y and or T-Branch(s) as required
7. Condensate Lift Pump(s) as shown on the contract documents
8. Refrigerant Ball Valves as shown on the contract documents
9. Service Software

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store products in a clean and dry place.

B. Comply with manufacturer's written rigging and installation instructions for unloading and moving to final installed location.

C. Handle products carefully to prevent damage, breaking, denting, and scoring. Do not install damaged products.

D. Protect products from weather, dirt, dust, water, construction debris, and physical damage.

1. Retain factory-applied coverings on equipment to protect finishes during construction and remove just prior to operating unit.
2. Cover unit openings before installation to prevent dirt and dust from entering inside of units. If required to remover coverings during unit installation, reapply coverings over openings after unit installation and remove just prior to operating unit.

E. Replace installed products damaged during construction.

1.7 WARRANTY

A. The units shall be covered by the manufacturer’s standard limited warranty for a period of 12 months from date of installation. If during this period, any part should fail to function properly due to defects in workmanship or material, it shall be replaced or repaired at the discretion of the manufacturer.

B. The units shall carry an extended manufacturer’s parts and compressor warranty for a period of 10 years from date of installation. The following steps shall be taken by the contractor to ensure systems are eligible for extended warranty.

1. System is designed and submitted using the approved application tool.
2. System installed by a contractor who has successfully completed the OEM factory training class.
3. Upon completion of installation and prior to final commissioning, contractor shall provide revised piping layout reflecting actual installation conditions to VRF manufacturer.
4. Provide a verified and submitted commissioning report to Mitsubishi Factory Service Department.

C. The contractor shall provide labor warranty as specified in the general conditions for this project.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide Trane/Mitsubishi air-cooled VRF system with simultaneous heating and cooling.

B. Other Acceptable Manufacturers

1. LG

2. Samsung
3. Toshiba/Carrier

C. Source Limitations: Obtain products from single source from single manufacturer including, but not limited to, the following:

1. Indoor and outdoor units, including accessories.
2. Controls and software.
3. Refrigerant energy recovery units.
4. Expansion valves.
5. Refrigerant isolation valves.
6. Specialty refrigerant pipe fittings.

2.2 SYSTEM DESCRIPTION

A. Direct-expansion (DX) VRF HVAC system(s) with variable capacity in response to varying cooling and heating loads. System shall consist of multiple indoor units, refrigerant energy recovery units, outdoor units, piping, controls, and electrical power to make complete operating system(s) complying with requirements indicated.

1. System shall include heat recovery at zone level refrigerant energy recovery units.
2. Common refrigerant circuit shared by all indoor units connected to each system.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. AHRI Compliance: System and equipment performance certified according to AHRI 1230.

D. ASHRAE Compliance:

1. ASHRAE 15: For safety code for mechanical refrigeration.
2. ASHRAE 62.1: For indoor air quality.
3. ASHRAE 135: For control network protocol with remote communication.
4. ASHRAE/IES 90.1 Compliance: For system and component energy efficiency.

E. UL Compliance: Comply with UL 1995.

2.3 EXPOSED, WALL-MOUNTED INDOOR UNIT

A. The indoor unit shall be factory assembled, wired, and run tested. Contained within the unit shall be all factory wiring, internal piping, the electronic modulating linear expansion device, control circuit board, and fan motor. The unit shall have a self-diagnostic function, 3-minute time delay mechanism, an auto restart function. The unit shall be provided with a face mounted infrared receiver for use with a handheld wireless remote controller. The unit shall have an integral return air sensor.

B. The unit casing shall have a white finish, with multi directional drain and refrigerant piping offering four (4) directions for refrigerant piping and four (4) directions for condensate drainage. The unit shall be secured firmly to the wall with factory mounting plate.

C. The indoor fan shall consist of a cross-flow fan with a single direct drive motor. The indoor fan shall be statically and dynamically balanced to run on a motor with permanently lubricated bearings. A manual adjustable guide vane shall be provided to change the airflow from side to side (left to right) as desired. A motorized air sweep louver shall provide an automatic change in airflow by directing the air up and down to provide uniform air distribution. The indoor fan shall have multiple speeds.

D. Return air shall be filtered by means of an easily removable, washable filter.

E. The indoor coil shall be constructed as follows:

1. The indoor coil shall be of nonferrous construction with slit fins on copper tubing.
2. The tubing shall have inner grooves for high efficiency heat exchange.
3. All tube joints shall be brazed with phos-copper or silver alloy.
4. The coils shall be pressure tested at the factory.
5. A condensate pan and drain shall be provided under the coil.
6. The coil fins shall be coated with hydrophilic paints.
7. The optional field installed condensate lift mechanism shall be able to raise drain water 29.5 inches water column above the condensate pan.
8. Both refrigerant lines to the indoor units shall be insulated.

F. Use 18 AWG, 25pF/ft nom., 60.7 Ω impedance, braid or foil shielded, twisted pair wire for communications wiring. Splicing of communication wiring shall not be permitted.

G. This unit shall use controls provided by the original equipment manufacturer to perform functions necessary to operate the system.

2.4 OUTDOOR, AIR-SOURCE HEAT RECOVERY UNITS (6 TO 44 TONS NOMINAL CAPACITY)

A. Basis-of-Design Product: Mitsubishi Heat Recovery Air Source outdoor units.

B. The Heat Recovery Air Source unit shall be used specifically with OEM Heat Recovery systems (simultaneous heating and cooling). Units shall have weather tight construction for outdoor installation, (outdoor unit).

C. Each zone shall have a dedicated space temperature controller. The Heat Recovery system shall provide simultaneous heating and cooling without the use of reheat.

D. Heat Recovery outdoor units shall include a low temperature/low pressure gas line, high temperature/high pressure gas line, and a medium temperature/high pressure liquid line. All three lines will connect from the outdoor unit to each mode control units.

E. Heat Recovery outdoor units shall be equipped with multiple circuit boards. These boards shall perform all functions necessary for operation of the outdoor units.

F. The outdoor unit shall be completely factory assembled, internally piped and wired. Each unit shall be run tested at the factory.

1. The combination ratio of the nominal indoor cooling capacity versus the nominal outdoor rated cooling capacity shall range from 50% to 130%.
2. Outdoor unit shall have a sound rating no higher than 62/83(Pressure/Power) dB(A).
3. Unit shall have a night quiet setting to reduce nighttime sound levels.

4. All refrigerant lines from the outdoor unit to the MCU (Mode Change Unit), and or from MCUs to IDUs (Indoor Units,) shall be field insulated with a minimum insulation as referenced in the VRF manufacturer's IOM.
5. The outdoor unit shall have an accumulator with crank case heater and controls.
6. The outdoor unit shall have a high pressure safety switch, fuse, over-current protection and crank case heater.
7. If the outdoor unit is above the indoor unit, the outdoor unit shall have the ability to operate with a maximum height difference of 361ft.
8. If the outdoor unit is below the indoor unit, the outdoor unit shall have the ability to operate with a maximum height difference of 131 ft.
9. The system shall have a maximum total refrigerant tubing length of 3281ft.
10. The maximum length between outdoor unit and the furthest indoor units is not to exceed 656 ft (722 equivalent feet).
11. The maximum height difference between MCU boxes shall be 49 ft.
12. The maximum height difference between indoor units shall be 49 ft.
13. The outdoor unit shall be capable of operating in cooling mode from 23°F to 120°F.
14. The outdoor unit shall be capable of operating from 23°F to 5°F if the system is installed and configured per manufacturers guidelines.
15. The outdoor unit shall be capable of operating in heating mode from 75°F to -13°F ambient temperatures without additional low ambient controls, additional modules, or low ambient accessories.
16. The outdoor unit shall have a high efficiency oil separator plus additional logic controls to ensure adequate oil volume in the compressor is maintained.
17. The outdoor units shall provide continuous heating during oil return and the defrost cycle through the use of rotational defrost. (multiple module systems)
18. Units shall have a snow blower feature to ensure the dispersion of accumulated snow.

G. The unit casing(s) shall be fabricated of galvanized steel, bonderized and finished with a powder coated baked enamel.

H. The outdoor condenser fan shall be furnished with direct drive motors(s). All fan motors shall have inherent motor protection, and permanently lubricated bearings. All fan motors shall be mounted for quiet operation. All fans shall be provided with a raised guard to prevent contact with moving parts. The fans shall have vertical discharge airflow.

I. R410A refrigerant shall be required for VRF outdoor unit systems.

J. System shall use Polyvinylether (PVE) oil. Due to the increased risk of hydrolysis and formation of acids, Polyolester (POE) oil shall not be acceptable.

K. The outdoor condenser coil shall be of nonferrous construction with lanced or corrugated plate fins on copper tubing. The condenser coil shall have Blue Fin anti-corrosion protection as a standard feature. The coil shall be protected with an integral metal guard. The coil fins shall be coated with hydrophilic paints. Coil shall be capable of withstanding 1000 hour salt spray test.

L. The outdoor units shall be equipped with inverter driven vapor injection asymmetric scroll compressor(s). The asymmetric design will allow for only one point of contact for the scroll compressor blades resulting in reduced friction, and increased efficiency. Conventional scroll compressors with 2-points of contact will not be allowed due to their inherent inefficiency.

1. The outdoor unit compressor shall utilize inverter driven technology to modulate capacity. The compressors shall also utilize advanced technology adaptive sine wave control for reduced harmonics and faster frequency acceleration.
2. The compressor shall be capable of 1/60th second advanced micro-control.

3. The outdoor unit compressor shall utilize vapor injection technology which shall increase the mass flow rate of refrigerant, resulting in improved performance for low temperature conditions.
4. The compressor will be equipped with an internal thermal overload protection.
5. The compressor shall be mounted to avoid the transmission of vibrations.

M. Use 18 AWG, 25pF/ft nom., 60.7 Ω impedance, braid or foil shielded, twisted pair wire for communications wiring. Splicing of communication wiring shall not be permitted.

2.5 MODE CONTROL UNITS (MCUS)

A. The MCU (Mode Change Unit) shall be used for applications requiring simultaneous heating and cooling.

B. MCUs require they be used in conjunction with VRF Heat Recovery water source or air source units. These units shall be equipped with a circuit board that shall perform all functions necessary for operation.

C. The MCU (Mode Change Unit) shall be completely factory assembled, internally piped and wired. Unit shall be run tested. This unit shall be mounted indoors.

D. Each MCU shall be capable of transferring heat to connected associated indoor units, and to the connected water source or air source unit. This shall allow simultaneous heating and cooling without the need for reheat.

E. Isolation valves with access ports shall be provided on the entering and leaving refrigerant circuits as shown on the drawings.

F. Additional subcooling shall be provided at the MCU. The additional subcooling shall mitigate losses due to pipe length and heat gain, and ensure scheduled capacity at the indoor unit.

G. MCU (Mode Change Units) shall be provided in three sizes, 4-port, 6-port, and dedicated 2-port. The heat recovery water source or air source unit shall be capable of connecting to multiple MCUs (Mode Change Units).

H. The 4-port MCU shall connect up to 4 indoor units when the sum of the indoor unit’s capacity is less than 120 MBH. Optionally, the 6-port MCUs shall connect up to 6 indoor units where the sum of indoor unit’s capacity is less than 180 MBH.

I. The dedicated 2-port MCU shall be used to connect individual Indoor units whose capacity greater than or equal to 36 MBH, and where the sum of the MCUs capacity is less than 192 MBH.

J. When connecting indoor units with capacities greater than 36 MBH to a 4-port, 6-port, or dedicated 2-port MCU, two ports shall be twinned together at the MCU to deliver the required refrigerant. The two MCU refrigerant valves shall operate simultaneously.

K. IDUs with capacity in excess of 48MBH shall not be connected to 4-port or 6-port MCUs. They should be used exclusively with a dedicated 2-port MCUs.

L. IDUS with capacity less than 36MBH indoor unit shall not be connected to a dedicated 2-port MCUs.

M. The MCU casing shall be fabricated of galvanized steel. Each cabinet shall house a liquid-gas separator and multiple refrigeration control valves. The unit shall house two tube-in-tube heat exchangers (sub cooling) to ensure heating and cooling capacity at the indoor unit.

N. The MCU shall be furnished with multiple two position refrigerant valves. Linear electronic expansion valves shall be used to control the variable refrigerant flow.

O. An integral MCU condensate pan and drain connection shall be provided.

P. Use 18 AWG, 25pF/ft nom., 60.7 Ω impedance, braid or foil shielded, twisted pair wire for communications wiring. Splicing of communication wiring shall not be permitted.

2.6 SYSTEM ACCESSORIES

A. Y-Joint Kits- are a required component for basis of design VRF systems with multiple evaporators or MCU's on the same system. Y-joints shall be provided for liquid, suction, and hot gas fittings as required. Y-joints shall be provided with polystyrene insulation. Y-branches shall facilitate different pipe sizes without having to braze additional fittings. Field fabrication or substitution of non-Mitsubishi Y-Joints shall void warranty. Kits shall be installed per manufacturer guidelines. Requires field installation.

B. T-Joint Kits – are a required component for basis of design VRF systems capable of operating multiple outdoor modules on a single system. The T-Joint shall be provided for liquid, suction, and hot gas fittings as required. T-Joints shall be provided with polystyrene insulation. T-Branches shall facilitate different pipe sizes without having to braze additional fittings. Field fabrication or substitution of non-Mitsubishi T-joints shall void warranty. Kits shall be installed per manufacturer guidelines. Requires field installation.

C. EEV KITs- the EEV (Electronic Expansion Valve) provides refrigerant management of indoor units. The EEV shall be required for field installation on ceiling suspended (floor) indoor units. Heat Recovery systems shall use the one unit EEV kit. Heat Pump systems may utilize the one, two, or three unit EEV kits. Kits shall be installed per manufacturer guidelines. Requires field installation.

D. Condensate Drain Pumps shall be provided for field installation as required for efficient condensate management. Condensate pumps shall be capable of 29.5" of lift to allow condensate to reach the closest gravity drain line. Condensate pumps shall include a check valve to prevent water form flowing back into the indoor unit. Pump shall be mounted in the chassis of the indoor unit. Pump shall draw on required power from the associated indoor unit. Requires field installation (Standard factory installed for all ceiling cassettes).

E. Refrigerant Isolation Ball Valves - shall be provided for field installation as specified by the contract documents. Valves shall utilize a uni-body full port design to minimize leaks and internal pressure drops. Valves shall be rated for 700PSIG and are offered with an optional factory insulation package. Valves shall be factory tested under pressure. Valves shall require polytetrafluoroethylene (PTFE) seals and gaskets. No synthetic O-rings are allowed. Design shall permit valve operation without removal of seal cap. Valves shall have a temperature operation range of -40°F to 300°F. Valves 5/8" and smaller shall be flare fittings. Valves larger than 5/8" shall be sweat fittings. Valves shall be provided with formed and fitted insulated jacket. Requires field installation.

F. Wired Remote Temperature Controller shall be used with all VRF Indoor Units. Remote shall utilize a multi-function LCD display and shall possess the following functionality:

1. Power on/off setting
2. Temperature set point control
3. Built-in room temperature sensor
4. Operation mode: Auto-Cool-Dry-Fan-Heat
5. Fan speed: Auto-Low-Med-High
6. Filter alarm reset (timer)
7. Individual airflow blade control on cassette units
8. Controls up to 16 IDUs
9. Real-time clock includes current time, day display
10. Daylight savings time adjustment (program in the date)
11. Weekly operating scheduling
12. Motion Detection/Away function (applies to enabled IDUs)
13. Upper/Lower temperature limit settings
14. Up to 2 remotes may be averaged as single controller for 1 IDU
15. Error display
16. Service Mode provides configuration settings
17. Security lock code

G. External Contact Interface shall be provided and shall permit the on/off control of indoor units through an external input. The device shall also allow the indoor unit to interlock control of external devices. This will allow the external devices to operate in sequence with the interlocked indoor unit.

H. Filter Box with high efficiency filter shall be provided for each ducted fan coil unit.

I. Provide wind baffles and discharge hood for each condensing unit for low ambient cooling operation.

2.7 SYSTEM CONTROLS

A. The VRF system network controls shall consist of individual controllers, system controllers, and an integrated management system. The Mitsubishi VRF System Network Controls shall support operation monitoring, scheduling, error monitor, power distribution, personal browsers, tenant billing, online maintenance support, and integration with Building Management Systems (BMS) using BACnet® interfaces.

B. The VRF system network controls shall be capable of supporting remote controllers, system controllers, centralized controllers, an integrated web-based interface, graphical user workstation, and system integration to Building Management Systems via BACnet®.

C. The VRF system network controls shall operate at 12VDC. Controller power and communications shall be via a common non-polar communications bus.

D. Control wiring shall be installed in a system daisy chain configuration from the wired remote controller to the indoor unit, to the and to outdoor unit. Control wiring to wired remote controllers shall be run from the indoor unit terminal block to the controller associated with that unit.

E. Control wiring for system controllers, and centralized controllers shall be installed in a daisy chain configuration from interface module to interface module, to system controllers, to the power supply.

F. For communication wiring between ODUs, IDUs, MCU, system controller, and remote controllers use 18 AWG, 25pF/ft nom., 60.7 Ω impedance, braid or foil shielded, twisted pair wire. Splicing of communication wiring shall not be permitted.

G. The VRF web user interface shall be capable of being networked with all connected system controllers for web based control.

H. Network wiring shall be CAT-5e with RJ-45 connection.

2.8 VRF SYSTEM CONTROLLER

A. The VRF System Controller is an intelligent field panel that communicates with VRF Outdoor Unit(s), Indoor Unit(s) and other VRF controllers. The VRF System Controller shall scan all controllers to update information and coordinate building control. The VRF System Controller shall connect to associated indoor and outdoor units utilizing a dedicated control network, and over a local area network (LAN) to provide a web page-based user interface available wherever the building's network access is available. The VRF System Controller shall be housed in a protective enclosure suitable for wall-mounting in a mechanical or electrical equipment room.

B. The VRF System Controller shall allow a building operator to view the system using a PC with a standard web browser.

C. The VRF System Controller shall include a user interface that includes control and monitoring of each Indoor unit through a standard graphical display with convenient pop-up controller screen to adjust comfort settings for each zone.

D. The VRF System Controller shall be capable of controlling a maximum of 256 indoor units via a PC. The VRF System Controller shall support operation superseding that of the remote controllers, system configuration, 1-day/daily/weekly scheduling, monitoring of operation status, error email notification, online maintenance tool and malfunction monitoring.

E. Provide an operator workstation for use in hosting the VRF system controller software. Refer to Division 230900 for operator workstation requirements.

F. The VRF System Controller shall have a basic set of operation controls which can be applied to an individual indoor unit, a group of indoor units (up to 256 indoor units), or all indoor units (collective batch operation).

G. The basic set of operation controls for the VRF System Controller shall include on/off, operation mode selection (auto, cool, heat, dry, and fan), temperature setting, fan speed setting, airflow direction setting, error email notification, and online maintenance.

H. Since the VRF System Controller provides centralized control, it shall be able to enable or disable operation of local remote controllers via the operator workstation. In terms of scheduling, the VRF SC shall allow the user to define 1-day, daily, and annual schedules with operations consisting of ON/OFF, mode selection, temperature setting, permit/prohibit of wireless/wired remote controllers.

I. The system shall detect and store alarms in the Alarm Log. The Alarm Log shall display critical data about the alarm, including the location of the device, and the time of occurrence. Alarms shall be routed by e-mail to stationary or mobile devices. Capacity to store up to 1024 alarm events on time specific basis shall be required.

J. Database changes made by other users shall automatically be reflected in the VRF System Controller without the need for a central server. The system database be capable of archiving or backing up data for local or offsite storage. This is desirable in the event the date is ever needed for restoring the system. A built-in SD card slot provides for on-board but removable data backup storage.

K. A password shall protect the VRF control system from unauthorized access. Each operator is assigned a role. Roles are defined by access rights. Pre-defined roles shall be selected from the VRF System Controller interface. Operators shall have access only to those features which define their roles. Roles may also be customized. An operator with administrative-level security shall access all information on the system and shall have the ability to alter passwords and create new security roles.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine products before installation. Reject products that are wet, moisture damaged, or mold damaged.

C. Examine roughing-in for piping and tubing to verify actual locations of connections before equipment installation.

D. Examine roughing-in for ductwork to verify actual locations of connections before equipment installation.

E. Examine roughing-in for wiring and conduit to verify actual locations of connections before equipment installation.

F. Examine walls, floors, roofs, and outdoor pads for suitable conditions where equipment will be installed.

G. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

H. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 EQUIPMENT INSTALLATION, GENERAL

A. Clearance:

1. Maintain manufacturer's recommended clearances for service and maintenance.
2. Maintain clearances required by governing code.

B. Loose Components: Install components, devices, and accessories furnished by manufacturer, with equipment, that are not factory mounted.

3.3 INSTALLATION OF INDOOR UNITS

A. Install units to be level and plumb while providing a neat and finished appearance.

B. Unless otherwise required by VRF HVAC system manufacturer, support ceiling-mounted units from structure above using threaded rods; minimum rod size of 3/8 inch.

C. Adjust supports of exposed and recessed units to draw units tight to adjoining surfaces.

D. Protect finished surfaces of ceilings, floors, and walls that come in direct contact with units. Refinish or replaced damaged areas after units are installed.

E. In rooms with ceilings, conceal piping and tubing, controls, and electrical power serving units above ceilings.

F. In rooms without ceiling, arrange piping and tubing, controls, and electrical power serving units to provide a neat and finished appearance.

G. Provide lateral bracing if needed to limit movement of suspended units to not more than 0.25 inch.

H. For wall-mounted units that are exposed, conceal piping and tubing, controls, and electrical power serving units within walls.

I. Attachment: Install hardware for proper attachment to supported equipment.

J. Grouting: Place grout under equipment supports and make bearing surface smooth.

3.4 INSTALLATION OF OUTDOOR UNITS

A. Install units to be level and plumb while providing a neat and finished appearance.

B. Install outdoor units on support structures indicated on Drawings.

3.5 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage VRF HVAC system manufacturer's service representative to advise and assist installers; witness testing; and observe and inspect components, assemblies, and equipment installations, including controls and connections.

1. Field service shall be performed by a factory trained and authorized service representative of VRF HVAC system manufacturer whose primary job responsibilities are to provide direct technical support of its products.

a. Additional factory-authorized representatives may assist with completion of certain activities only if supervised by manufacturer's employee. A factory-authorized representative shall not provide assistance without manufacturer's employee supervision.

2. Manufacturer shall provide on-site visits during the course of construction at installation milestones indicated. System Installer shall coordinate each visit in advance to give manufacturer sufficient notice to plan the visit.

    a. First Visit: Kick-off meeting.
    b. Second Visit: At approximately 50 percent completion of system(s).
    c. Third Visit: Final inspection before system startup.

3. Kick-off Meeting:

    a. Meeting shall include system Installer and other related trades with sole purpose of reviewing VRF HVAC system installation requirements and close coordination required to make a successful installation.
    b. Meeting shall be held at Project site and scheduled at a mutually agreed to time that occurs before the start of any part of system installation.
    c. Meeting shall cover the following as a minimum requirement:

        1) Review of latest issue of Contract Documents, Drawings, and Specifications, relevant to VRF HVAC systems.
        2) Manufacturer's installation requirements specific to systems being installed.
        3) Review of all relevant VRF HVAC system submittals, including delegated-design submittals.
        4) Required field activities related installation of VRF HVAC system.
        5) Project team communication protocol, contact information, and exchange of responsibilities for each party involved, including manufacturer, supplier, system Installer, and other related trades.

4. Site Visits: Activities for each site visit shall include the following:

    a. Meet with VRF HVAC system Installer to discuss field activities, issues, and suggested methods to result in a successful installation.
    b. Offer technical support to Installer and related trades as related to VRF system(s) being installed.
    c. Review progress of VRF HVAC system(s) installation for strict compliance with manufacturer's requirements.
    d. Advise and, if necessary, assist Installer with updating related refrigerant calculations and system documentation.
    e. Issue a report for each visit, documenting the visit.

        1) Report to include name and contact information of individual making the visit.
        2) Date(s) and time frames while on-site.
        3) Names and contact information of people meeting with while on-site.
        4) Clearly identify and list each separate issue that requires resolution. For each issue, provide a unique identification number, relevant importance, specific location or equipment identification, description of issue, recommended corrective action, and follow-up requirements needed. Include a digital photo for clarification if deemed to be beneficial.

5. Final Inspection before Startup:

    a. Before inspection, Installer to provide written request to manufacturer stating the system is fully installed according to manufacturer's requirements and ready for final inspection.

b. All system equipment and operating components shall be inspected. If components are inaccessible for inspection, they shall be made accessible before the final inspection can be completed.
c. Manufacturer shall provide a comprehensive inspection of all equipment and each operating component that comprise the complete system(s). Inspection shall follow a detailed checklist specific to each equipment and operating component.
d. Inspection reports for indoor units shall include, but not be limited to, the following:

1) Unit designation on Drawings.
2) Manufacturer model number.
3) Serial number.
4) Network address, if applicable.
5) Each equipment setting.
6) Mounting, supports, and restraints properly installed.
7) Proper service clearance provided.
8) Wiring and power connections correct.
9) Line-voltage reading(s) within acceptable range.
10) Wiring and controls connections correct.
11) Low-voltage reading(s) within an acceptable range.
12) Controller type and model controlling unit.
13) Controller location.
14) Temperature settings and readings within an acceptable range.
15) Humidity settings and readings within an acceptable range.
16) Condensate removal acceptable.
17) Fan settings and readings within an acceptable range.
18) Unit airflow direction within an acceptable range.
19) If applicable, fan external static pressure setting.
20) Filter type and condition acceptable.
21) Noise level within an acceptable range.
22) Refrigerant piping properly connected and insulated.
23) Condensate drain piping properly connected and insulated.
24) If applicable, ductwork properly connected.
25) If applicable, external interlocks properly connected.
26) Remarks.

e. Inspection reports for outdoor units shall include, but not be limited to, the following:

1) Unit designation on Drawings.
2) Manufacturer model number.
3) Serial number.
4) Network address, if applicable.
5) Each equipment setting.
6) Mounting, supports, and restraints properly installed.
7) Proper service clearance provided.
8) Wiring and power connections correct.
9) Line-voltage reading(s) within acceptable range.
10) Wiring and controls connections correct.
11) Low-voltage reading(s) within an acceptable range.
12) Condensate removal acceptable.
13) Noise level within an acceptable range.
14) Refrigerant piping properly connected and insulated.
15) Condensate drain piping properly connected and insulated.
16) Remarks.

f. Inspection reports for indoor, dedicated outdoor air ventilation units shall include, but not be limited to, the following:

1) Unit designation on Drawings.
2) Manufacturer model number.
3) Serial number.
4) Network address, if applicable.
5) Each equipment setting.
6) Mounting, supports, and restraints properly installed.
7) Proper service clearance provided.
8) Wiring and power connections correct.
9) Line-voltage reading(s) within acceptable range.
10) Wiring and controls connections correct.
11) Low-voltage reading(s) within an acceptable range.
12) Controller type and model controlling unit.
13) Controller location.
14) Temperature settings and readings within an acceptable range.
15) Humidity settings and readings within an acceptable range.
16) Condensate removal acceptable.
17) Fan settings and readings within an acceptable range.
18) Fan external static pressure setting.
19) Filter type and condition acceptable.
20) Noise level within an acceptable range.
21) Refrigerant piping properly connected and insulated.
22) Condensate drain piping properly connected and insulated.
23) Automatic dampers properly installed and operating.
24) Ductwork properly connected.
25) If applicable, external interlocks properly connected.
26) Remarks.

g. Inspection reports for energy recovery ventilators shall include, but not be limited to, the following:

1) Unit designation on Drawings.
2) Manufacturer model number.
3) Serial number.
4) Network address, if applicable.
5) Each equipment setting.
6) Mounting, supports, and restraints properly installed.
7) Proper service clearance provided.
8) Wiring and power connections correct.
9) Line-voltage reading(s) within acceptable range.
10) Wiring and controls connections correct.
11) Low-voltage reading(s) within an acceptable range.
12) Controller type and model controlling unit.
13) Controller location.
14) Temperature settings and readings within an acceptable range.
15) Humidity readings.
16) Condensate removal acceptable.
17) Fan settings and readings within an acceptable range.
18) Fan external static pressure setting.
19) Filter type and condition acceptable.
20) Noise level within an acceptable range.
21) Automatic dampers properly installed and operating.
22) Ductwork properly connected.

23) If applicable, external interlocks properly connected.
24) Remarks.

h. Inspection reports for hydronic units shall include, but not be limited to, the following:

1) Unit designation on Drawings.
2) Manufacturer model number.
3) Serial number.
4) Network address, if applicable.
5) Each equipment setting.
6) Mounting, supports, and restraints properly installed.
7) Proper service clearance provided.
8) Wiring and power connections correct.
9) Line-voltage reading(s) within acceptable range.
10) Wiring and controls connections correct.
11) Low-voltage reading(s) within an acceptable range.
12) Controller type and model controlling unit.
13) Controller location.
14) Temperature settings and readings within an acceptable range.
15) Condensate removal acceptable.
16) Noise level within an acceptable range.
17) Refrigerant piping properly connected and insulated.
18) Hydronic piping properly connected and insulated.
19) Proof of water flow checked for proper operation.
20) Condensate drain piping properly connected and insulated.
21) If applicable, external interlocks properly connected.
22) Remarks.

i. Installer shall provide manufacturer with the requested documentation and technical support during inspection.
j. Installer shall correct observed deficiencies found by the inspection.
k. Upon completing the on-site inspection, manufacturer shall provide a written report with complete documentation describing each inspection step, the result, and any corrective action required.
l. If corrective action is required by Installer that cannot be completed during the same visit, provide additional visits, as required, until deficiencies are resolved and systems are deemed ready for startup.
m. Final report shall indicate the system(s) inspected are installed according to manufacturer's requirements and are ready for startup.

B. Perform the following tests and inspections with the assistance of manufacturer's service representative:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
2. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Refrigerant Tubing Positive Pressure Testing:

1. Comply with more stringent of VRF HVAC system manufacturer's requirements and requirements indicated.
2. After completion of tubing installation, pressurize tubing systems to a test pressure of not less than 1.5 times VRF HVAC system operating pressure, but not less than 600 psig, using dry nitrogen.
3. Successful testing shall maintain a test pressure for a continuous and uninterrupted period of 24 hours. Allowance for pressure changes attributed to changes in ambient temperature are acceptable.
4. Prepare test report to record the following information for each test:

    a. Name of person starting test, company name, phone number, and e-mail address.
    b. Name of manufacturer's service representative witnessing test, company name, phone number, and e-mail address.
    c. Detailed description of extent of tubing tested.
    d. Date and time at start of test.
    e. Test pressure at start of test.
    f. Outdoor temperature at start of test.
    g. Name of person ending test, company name, phone number, and e-mail address.
    h. Date and time at end of test.
    i. Test pressure at end of test.
    j. Outdoor temperature at end of test.
    k. Remarks:

5. Submit test reports for Project record.

D. Refrigerant Tubing Evacuation Testing:

1. Comply with more stringent of VRF HVAC system manufacturer's requirements and requirements indicated.
2. After completion of tubing positive-pressure testing, evacuate tubing systems to a pressure of 500 microns.
3. Successful testing shall maintain a test pressure for a continuous and uninterrupted period of one hour(s) with no change.
4. Prepare test report to record the following information for each test:

    a. Name of person starting test, company name, phone number, and e-mail address.
    b. Name of manufacturer's service representative witnessing test, company name, phone number, and e-mail address.
    c. Detailed description of extent of tubing tested.
    d. Date and time at start of test.
    e. Test pressure at start of test.
    f. Outdoor temperature at start of test.
    g. Name of person ending test, company name, phone number, and e-mail address.
    h. Date and time at end of test.
    i. Test pressure at end of test.
    j. Outdoor temperature at end of test.
    k. Remarks:

5. Submit test reports for Project record.
6. Upon successful completion of evacuation testing, system shall be charged with refrigerant.

E. System Refrigerant Charge:

1. Using information collected from the refrigerant tubing evacuation testing, system Installer shall consult variable refrigerant system manufacturer to determine the correct system refrigerant charge.
2. Installer shall charge system following VRF HVAC system manufacturer's written instructions.
3. System refrigerant charging shall be witnessed by system manufacturer's representative.
4. Total refrigerant charge shall be recorded and permanently displayed at the system's outdoor unit.

F. Products will be considered defective if they do not pass tests and inspections.

G. Prepare test and inspection reports.

3.6 STARTUP SERVICE

A. Engage a VRF HVAC system manufacturer's service representative to perform system(s) startup service.

1. Service representative shall be a factory trained and authorized service representative of VRF HVAC system manufacturer.
2. Complete startup service of each separate system.
3. Complete system startup service according to manufacturer's written instructions.

B. Startup checks shall include, but not be limited to, the following:

1. Check control communications of equipment and each operating component in system(s).
2. Check each indoor unit's response to demand for cooling and heating.
3. Check each indoor unit's response to changes in airflow settings.
4. Check each indoor unit, MCU, and outdoor unit for proper condensate removal.
5. Check sound levels of each indoor and outdoor unit.

C. Installer shall accompany manufacturer's service representative during startup service and provide manufacturer's service representative with requested documentation and technical support during startup service.

1. Installer shall correct deficiencies found during startup service for reverification.

D. System Operation Report:

1. After completion of startup service, manufacturer shall issue a report for each separate system.
2. Report shall include complete documentation describing each startup check, the result, and any corrective action required.
3. Manufacturer shall electronically record not less than two hours of continuous operation of each system and submit with report for historical reference.

    a. All available system operating parameters shall be included in the information submitted.

E. Witness:

1. Invite Architect, Owner, and Commissioning Agent to witness startup service procedures.
2. Provide written notice not less than 20 business days before start of startup service.

3.7 ADJUSTING

A. Adjust equipment and components to function smoothly and lubricate as recommended by manufacturer.

B. Adjust initial temperature and humidity set points. Adjust initial airflow settings and discharge airflow patterns.

C. Set field-adjustable switches and circuit-breaker trip ranges according to VRF HVAC system manufacturer's written instructions, and as indicated.

D. Occupancy Adjustments: When requested within 12 months from date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

3.8 PROTECTION

A. Protect products from moisture and water damage. Remove and replace products that are wet, moisture damaged, or mold damaged.

B. Protect equipment from physical damage. Replace equipment with physical damage that cannot be repaired to new condition. Observable surface imperfections shall be grounds for removal and replacement.

C. Protect equipment from electrical damage. Replace equipment suffering electrical damage.

D. Cover and seal openings of equipment to keep inside of equipment clean. Do not remove covers until finish work is complete.

END OF SECTION

This page is intentionally left blank.

SECTION 23 82 16 - AIR COILS

PART 1 - GENERAL

1.1 SAFETY STANDARDS

A. Provide electric heating coil in compliance with the National Electric Code and listed by UL for zero clearance and so labeled.

1.2 CAPACITY RATINGS

A. Hydronic Coils: Certified per ARI 410.

1.3 SUBMITTALS

A. Submit manufacturer's product data including:

1. Performance data.
2. Accessories description
3. Operating weight.
4. Drawings showing:

    a. Dimensions.
    b. Sizes and locations of connections.

5. Support requirement.

1.4 FACE VELOCITY

Unless otherwise noted, face velocities shall not exceed the following:

A. Cooling Coils: 550 fpm.

B. Heating Coils: 600 fpm. (except electric coils)

PART 2 - PRODUCTS

2.1 ELECTRIC HEATING COILS

A. Manufacturers:

1. Berko
2. Carrier
3. Indeeco
4. QMark
5. Trane
6. Tutco

B. Description:

1. Type: Finned tubular, open coil.
2. Mounting: Casing suitable for insertion between fan section and filter section of air handling unit furnished per Section 23 73 13 As shown on the drawings.
3. Controls:

a. Provide factory-mounted and wired control panel.
b. Control Option: SCR
c. Thermostat: Room
d. Standard Features:

1) Thermal Cutoffs.
2) Airflow Switch.
3) Magnetic Contactors.
4) Control Transformer.
5) Fuses.

e. Optional Features:

1) Disconnect Switch.
2) Remote Panel.

2.2 HYDRONIC COILS

A. Manufacturers:

1. Aerofin
2. Airtherm
3. Carrier
4. Colmac
5. Daikin Applied
6. Dunham Bush
7. Heatcraft
8. Nationwide Coils
9. York

2.3 HEATING COILS (HOT WATER)

A. Construction:

1. Tubes: Copper.
2. Fins: Aluminum
3. Casing: 16-gauge galvanized steel
4. Max. service conditions:

a. 200 psig.
b. 220^0

5. Certified in accordance with ARI Standard 410.

2.4 COOLING COILS (CHILLED WATER)

A. Construction:

1. Tubes: Copper.
2. Fins: Aluminum.
3. Casing: 16-gauge stainless steel.
4. Max.service conditions:

   a. 200 psig.
   b. 220^0

5. Certified in accordance with ARI Standard 410.

2.5 CORROSION PROTECTION

A. Where shown on drawings provide a baked phenolic anti-corrosion coating on all surfaces of the coil including fins, tubes, and headers and all other copper material within the unit.

B. Coating shall be applied by a firm specializing in such work. The procedure shall be in accordance with the firm's established process, including dipping and spraying to thoroughly coat all surfaces.

C. Performance of the coil shall not be degraded by the coating.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install coils level and plumb.

B. Provide necessary auxiliary support.

C. Adjust air flow switch for safe operation.

D. Check and adjust all controls.

E. Pipe condensate drain from cooling coils as shown on the drawings or to nearest floor drain or mop sink.

F. Coordinate electrical requirements with Division 26 prior to ordering. Report any discrepancies to the Engineer for resolution.

G. For multiple coil sections, extend all connections insulated through unit casing or ductwork to connection points outside of casing or ductwork. Provide reverse return piping arrangement.

END OF SECTION

This page is intentionally left blank.

SECTION 23 82 19 - FAN COIL UNITS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Factory constructed vertical or horizontal Fan Coil Units.

1.2 RELATED WORK

A. Section 23 05 13 – Motors and Starters
Section 23 05 30 – Electronic Speed Controllers
Section 23 09 00 – Automatic Temperature Controls
Section 23 40 00 – Air Cleaning
Section 23 82 16 – Coils

1.3 REFERENCES

A. NFPA 90A - Installation of Air Conditioning and Ventilation Systems.

B. SMACNA - HVAC Duct Construction Standards.

1.4 QUALITY ASSURANCE

A. Fan Coil Units: Product of manufacturer regularly engaged in production of components that issues complete catalog data on total product offering.

B. Fan Coil Units: Certify capacity, static pressure, fan speed, brake horsepower and selection procedures in accordance with ARI 430-89.

C. Air Coils: Certify capacities, pressure drops and selection procedures in accordance with ARI 410-87.

1.5 SUBMITTALS

A. Submit as-built drawings and product data under provisions of Division 1.

B. As-built drawings shall show unit configuration in direction of airflow, and shall indicate assembly and unit dimensions.

C. Product data shall indicate dimensions, weights, capacities, fan performance, motor electrical characteristics, and finishes of materials.

D. Submit product data of filter sizes and quantities, filter performance, and filter frames.

E. Submit manufacturer’s installation instructions under provisions of Division 1.

1.6 OPERATION AND MAINTENANCE DATA

A. Submit operation and maintenance data under provisions of Division 1.

B. Include instructions for lubrication, filter replacement, motor and drive replacement, spare parts lists, and wiring diagrams.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Do not operate units for any purpose, temporary or permanent, until ductwork is clean, filters are in place, bearings lubricated, and fan has been test run under observation.

PART 2 - PRODUCTS

2.1 BLOWER COIL FAN COILS (400 TO 4,000 CFM)

A. Acceptable Manufacturers

1. Carrier
2. Daikin Applied
3. Enviro-Tec
4. First Company
5. International Environmental
6. Johnson Controls
7. Magic Aire
8. The Whalen Company
9. Titus
10. Trane Company

B. Construction

1. See drawings for unit configuration.
2. 18-gauge galvanized steel.
3. ABS or stainless-steel drain pan, positively sloped in every plane.
4. Provide units with condensate overflow shutdown switch.
5. Provide secondary drain pan where indicated.
6. All parts exposed to moisture are to be galvanized.
7. Insulate unit throughout with 1-½ LB closed cell foil faced insulation.
8. Motor access panels on either side of unit.
9. Mixing box with ½” extended drive rod, and low leakage dampers with edge seals. Mixing box to allow 100% economizer operation.

C. Filters

1. See drawings for filter efficiency.
2. Filter rack, sized to provide maximum of 500 fpm across filter.

D. Fan

1. The fans are DWDI (double width double inlet) forward curved centrifugal blower type. The fans are direct drive mounted directly to the motor shaft. All fans are dynamically balanced. All air handlers have a single fan.

2. Fan shaft to be supported by heavy duty permanently sealed ball bearings.
3. Fan and housing are corrosion resistant.

E. Motor

1. All motors are brushless DC (BLDC)/electronically commutated motors (ECM) factory-programmed and run-tested in assembled units. The motor controller is mounted in a control box with a built-in integrated user interface and LED tachometer. If adjustments are needed, motor parameters can be adjusted through momentary contact switches accessible without factory service personnel on the motor control board. Motors will soft-ramp between speeds to lessen the acoustics due to sudden speed changes. Motors can be operated at three speeds or with a field-supplied variable speed controller. The motor will choose the highest speed if there are simultaneous/conflicting speed requests. All motors have integral thermal overload protection with a maximum ambient operating temperature of 130.0 F and use permanently sealed ball bearings. Motors can operate at plus or minus 10 percent of rated voltage on all speed settings.
2. Motor to be permanently lubricated.
3. Fan Motors shall be heavy duty, high efficiency, and open drip-proof.
4. Motor horsepower shall not be changed without written approval from the Engineer.

F. Coils

1. Coils are leak tested at 350 PSIG minimum air pressure, suitable for working pressures up to 250 PSIG with air vents
2. Coils shall be designed with aluminum plate fins and copper tubes.
3. Fins shall have collars drawn, belled and firmly bonded to the tubes by means of mechanical expansion of the tubes. No soldering or tinning shall be used in the bonding process. Capacities, pressure drops and selection procedure shall be certified in accordance with ARI Standard 440.
4. Provide factory installed extended drain and vent connections for water coils.

2.2 HORIZONTAL OR VERTICAL CASED FAN COIL UNITS (300 TO 1300 CFM)

A. Acceptable Manufacturers

1. Carrier
2. Daikin Applied
3. Enviro-Tec
4. First Company
5. International Environmental
6. Johnson Controls
7. Magic Aire
8. The Whalen Company
9. Titus
10. Trane Company

B. Construction

1. See drawings for unit configuration.
2. 18-gauge galvanized steel.
3. For exposed units, provide baked powder finish in standard color. Color selection by architect.
4. ABS or stainless-steel drain pan, positively sloped in every plane.
5. Provide units with condensate overflow shutdown switch.

6. Provide secondary drain pan where indicated.
7. All parts exposed to moisture are to be galvanized.
8. Insulate unit throughout with closed cell insulation.
9. Refrigerator style leveling feet for vertical units.
10. Provide piping end pocket.

C. Fan

1. Aluminum, direct drive fan wheel and sheet metal housing.
2. Fan wheel to be forward curved, double width.
3. Fan and housing are corrosion resistant.

D. Motor

1. Provide permanent split capacitor and integral overload protection.
2. Motor to be permanently lubricated.
3. Motor shall be able to start at 78 percent of rated voltage and operate at 90 percent of rated voltage on all speed settings.
4. Three speed fan switch to be mounted on unit housing.

E. Coils

1. Coils are leak tested at 350 PSIG minimum air pressure, suitable for working pressures up to 250 PSIG with air vents
2. Coils shall be designed with aluminum plate fins and copper tubes.
3. Fins shall have collars drawn, belled and firmly bonded to the tubes by means of mechanical expansion of the tubes. No soldering or tinning shall be used in the bonding process. Capacities, pressure drops and selection procedure shall be certified in accordance with ARI Standard 440.
4. Provide factory installed extended drain and vent connections for water coils.

PART 3 - EXECUTION

3.1 GENERAL

A. Assemble and install in accordance with manufacturers written installation instructions and details on drawings.

B. Coordinate duct, piping and electrical work so as to provide access to unit for maintenance and filter replacement and coil removal with minimum disturbance of piping and no demolition of room construction or finishes.

C. Prior to unit start-up all controls shall be installed and tested.

D. Prior to initial start-up and for system testing install air filters to protect the unit and ductwork from dirt and debris. After the system has been tested and prior to turning the system over to the Owner, replace the pre-filters with new, clean filters as specified.

E. Prior to turning the system over to the Owner, all damages incurred during shipping, storing and installing shall be repaired. These repairs shall be sufficient to bring the equipment back to the quality standards, equal to the original manufacturing standards. These repairs shall include but are not limited to repairing painted surfaces, dent removal, combing coil fins, repairing or replacing wet, sagging or torn insulation, etc.

F. Pipe condensate full size to nearest floor drain. Provide trap 1” greater than fan static pressure.

G. Install units with adequate clearances as to:

1. Allow access to valves
2. Allow for coil pull, filter replacement and maintenance
3. Allow access doors to fully open
4. Provide required NEC clearances in front of disconnect and electrical components.

END OF SECTION

This page is intentionally left blank.

SECTION 23 82 39 - HEATING TERMINAL UNITS

PART 1 - GENERAL

1.1 SUBMITTALS

A. Submit manufacturer's product data:

1. Performance data.
2. Drawings.
    a. Dimensions
    b. Support requirements
    c. Size and location of connections
3. Enclosure gauges.
4. Accessories.
5. Parts lists.
6. Additional Submittal Requirements for Fan Coil Units, Cabinet Heaters and Unit Heaters:
    a. Wiring diagrams.
    b. Installation, operating and maintenance instructions.

PART 2 - PRODUCTS

2.1 GENERAL

A. Except as otherwise indicated, provide manufacturer's standard products as indicated by published product information, and as required for a complete installation.

2.2 HYDRONIC PROPELLER UNIT HEATERS

A. Manufacturers:

1. Daikin Applied
2. Modine
3. Sterling
4. Trane
5. Vulcan
6. Zehnder Rittling

B. Construction:

1. Coils:
    a. Fins: Aluminum.
    b. Tubes: Copper, expanded into fins.
    c. Working Pressure: 250 psig.

2. Casing:

    a. Material: 18-gauge steel.
    b. Corners: Rounded, 1” minimum radius.
    c. Finish: Phosphatized and painted inside and out with one coat of baked-on enamel.
    d. Fan Orifice: Integral with casing.

3. Motors:

    a. Type: Totally enclosed, shaded pole or split capacitor.
    b. Insulation: Class B.
    c. Mount: Resilient.
    d. Bearings: Sleeve or permanently lubricated ball bearings.
    e. Protection: Built-in thermal overload.

4. Guards

    a. Provide wire guards over propeller fans.

2.3 HYDRONIC CABINET UNIT HEATERS

A. Manufacturers:

1. Daikin Applied
2. Modine
3. Sterling
4. Trane
5. Vulcan
6. Zehnder Rittling

B. Construction:

1. Coils:

    a. Fins: Aluminum.
    b. Tubes: Copper.
    c. Working Pressure: 250 psig.

2. Casing:

    a. Material: 16-gauge steel.
    b. Corners: Rounded, 1” minimum radius.
    c. Finish: Phosphatized and painted inside and out with one coat of baked-on enamel.
    d. Color: Selected by Architect/Engineer from manufacturer’s standard colors.
    e. Heating Element Supports: Adjustable.
    f. Gaskets: Between front panel and enclosure.

3. Grilles: Fabricated steel bar grille.

    a. Directional Louvers: Under grille.

4. Fans:

    a. Arrangement: Blow-through
    b. Type: Multi-wheel, DWDI, FC, aluminum.
    c. Balance: Factory balance, static and dynamic.
    d. Drive: Direct.

5. Motors:

    a. Type: Shaded pole, permanently lubricated.
    b. Insulation: Class B.
    c. Speeds: Three.
    d. Protection: Built-in thermal overload.

6. Filters: Disposable, 3/4” or 1” thick.
7. Filters: Permanent.

    a. Type: Permanent.
    b. Material: Metal.
    c. Thickness: 1”

2.4 HYDRONIC FINNED TUBE RADIATION

A. Manufacturers:

1. Modine
2. Slant Fin
3. Smith’s Environmental Products
4. Sterling
5. Trane
6. Vulcan
7. Zehnder Rittling

B. Provide with high pressure rating allowing for 125 PSI operating pressure.

C. Heating Element: Provide heating elements consisting of copper tubes, mechanically expanded into aluminum fins.

1. If tubing size is changed from that specified, adjust rating to allow for change in water velocity.

D. Enclosure:

1. Material: 14-gauge steel.
2. Element Supports: Adjustable.

    a. Provide additional brackets where supply and/or return pipes are located in enclosure.

3. Finish:

    a. Primer: Zinc.
    b. Top Coat: Enamel.
    c. Color: Selected by Architect from manufacturer’s standards.

4. Gasket:

    a. Location: Between back panel and wall.
    b. Material: Sponge rubber.

5. Accessories: Provide manufacturer's standard accessories of steel, same gauge as enclosure, as required, including, but not limited to:

    a. Inside corners.
    b. Outside corners.
    c. End caps.
    d. Access sections.
    e. Extensions.
    f. Knob operated dampers, where shown on drawing.

2.5 ELECTRIC CABINET UNIT HEATERS

A. Manufacturers:

1. Berko
2. Indeeco
3. Markel
4. QMark
5. Raywall
6. Trane

B. Construction:

1. Casing:

    a. Material: 18-gauge steel (min) front cover, 20-gauge steel (min) side covers.
    b. Corners: Rounded.
    c. Finish: Phosphatized and painted inside and out.
    d. Color: Selected by Architect from manufacturer's standard colors.

2. Grilles: Stamped louver.
3. Heating Element: Finned, sheath type.
4. Controls:

    a. Contactors to energize heating coil.
    b. High temperature limit switch.
    c. Interlocks to prevent heater operation unless fan is running.
    d. Furnish line voltage thermostat for remote (wall) mounting.

5. CSA listed, ETL listed, or UL listed
6. Accessories:

    a. Mounting bracket.

2.6 ELECTRIC PLENUM HEATERS

A. Manufacturers:

1. Berko
2. Indeeco
3. Markel
4. QMark
5. Raywall

B. Construction:

1. Casing:

a. Material: Steel.
b. Finish: Powder coat.

2. Heating Element: Finned steel sheaths.
3. Clearance: Product shall be designed for use in concealed spaces with zero clearance to adjacent walls and ceilings.
4. CSA listed, ETL listed, or UL listed
5. Provide manufacturer's written certification that unit is suitable for use at altitude of the project.

PART 3 - EXECUTION

3.1 GENERAL

A. Locate units so clearance is provided for:

1. Service and maintenance.
2. Enclosure removal.

B. Level or pitch elements as required:

1. Install shims if necessary.

C. Touch-up finish after final adjustment.

D. Replace damaged enclosures.

E. Straighten bent fins.

F. Replace damaged elements.

END OF SECTION

This page is intentionally left blank.

SECTION 23 84 13 - HUMIDIFIERS

PART 1 - GENERAL

1.1 SUBMITTALS

A. Submit manufacturer's data, including:

1. Drawings showing overall dimensions of complete assembly.
2. Operating Weights.
3. Equipment support requirements.
4. Sizes and locations of connections.
5. Accessories.
6. Auxiliary support requirements.

PART 2 - PRODUCTS

2.1 HUMIDIFIER (ELECTRIC)

A. Manufacturers:

1. Design Basis: Nortec.
2. Other Acceptable Manufacturers:

B. Model: Plascondair.

C. Water Container:

1. Plastic.
2. Disposable.
3. Life: 43,000 lbs. of steam.

D. Heaters: Electrodes.

E. Capacity Control: Self-regulating.

F. Water Supply: Tap Water.

1. Additives for conductivity control: None.

G. Mounting: Wall

H. Drip Pan: Plastic.

I. Electrical:

1. Voltage: See Electrical Drawing.

2. Controls:

    a. Low voltage
    b. Solid state

3. Safety Controls:

    a. Thermal overload
    b. 24-Volt fuse
    c. Current operated Drain valve

J. Signal to change container: Indicator light.

K. Cabinet:

1. Material: Steel.
2. Finish: Baked enamel.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Mount unit on angle supports attached to roof steel or to mezzanine deck.

B. Mount unit above auxiliary drain pan.

C. Install steam nozzle in return air duct.

END OF SECTION

SECTION 23 90 00 - PROJECT CLOSEOUT

PART 1 - GENERAL

1.1 WORK INCLUDED

A. The contractor shall summarize and document adherence with the requirements of the specifications for project closeout including:

1. Copies of all warranties
2. Operation & Maintenance Manuals
3. Required tests
4. Test and balance reports
5. Record drawings
6. Permit requirements
7. Valve tag list

B. The contractor shall compile a closeout manual which shall include:

1. A list of all required tests and a place for signoff of date completed.
2. A list of all submittals with dates of acceptance by the engineer.
3. A schedule indicating dates for beginning testing and startup of equipment and dates of tests to be witnessed by the engineer, or designated representative, as required by the specifications.
4. Test procedures to be used for life safety systems.
5. Project close out check list.

C. The final closeout manual shall include the following:

1. Test reports as required by the specifications with signoff by the appropriate individual (engineer, architect, building official, etc.).
2. Documentation indicating all equipment is operating properly and is fully accessible for maintenance.
3. Copies of all warranties.
4. Test and Balance report.

D. This section only includes the requirements for documentation of the contract documents, by the contractor, for project completion. This section does not in any way decrease the scope of any of the drawings or specifications.

1.2 SUBMITTALS

A. Within 90 days after notice to proceed submit a preliminary closeout manual with the following:

1. A list of all required tests.
2. Preliminary schedule showing major milestones for completion of the mechanical/plumbing systems.

B. Within 30 days of substantial completion submit the completed closeout manual as described in Part 1.

C. Within 2 weeks of substantial completion submit a completed “Project Closeout Check List”, and the Final Closeout Manual.

D. Listed below is a checklist for use by the contractor. This list is not all inclusive for this project.

Project Close-Out Summary – Mechanical, Plumbing and Fire Protection

- ☐ All required submittals have been cleaned, submitted and either been approved or modified in accordance with the Engineer’s “make corrections noted” comments. Our records indicate the following submittals are still outstanding:
- ☐ Clean filters installed in all units. (Install just prior to building turnover)
- ☐ Attic stock provided as required in the following sections:
  - ☐ 22 11 23 Pump Shaft Seals
  - ☐ 23 05 01 Auxiliary Starter Contacts
  - ☐ 23 05 30 VFD Fuses
  - ☐ 23 40 00 Spare Filters
- ☐ All equipment has been started up and is functioning within manufacturers’ recommendations without any undue noise or vibration. (Submit a list of equipment with startup dates. Provide list no later than 120 days prior to project completion date).
- ☐ All vibration isolation has been installed and is operating properly.
- ☐ Duct access doors have been installed at fire and fire/smoke dampers and are properly fire-stopped and fire and fire/smoke dampers have been visually inspected to confirm that they are open.
- ☐ Access doors have been installed as required for concealed equipment, water hammer arrestors, valves, controls, actuators, etc.
- ☐ Chemical treatment system installed per specification and functioning properly.
- ☐ All equipment has been installed with the manufacturers recommended service clearances and is fully accessible for required maintenance.
- ☐ All equipment and piping are labeled per specifications.
- ☐ All hydronic, gas and plumbing piping cleaned, flushed and tested per specifications. Submit testing reports for record. Submit letter stating domestic water disinfection (chlorination) has been completed per the specifications.
- ☐ All action items are complete as listed in the action items reports. Submit a list of action items with sign off by Architect or Engineer for record. Punch list to be completed prior to turn over of building.
- ☐ Smoke control system tested and accepted by local authorities (in accordance with specifications). Submit dates for testing along with proposed test procedures.
- ☐ Temperature control system complete and tested per specifications.
- ☐ Test and balance complete and report submitted and accepted by Engineer.
- ☐ Fire sprinkler system and pump tested per specifications.

- ☐ Operation and maintenance manuals submitted with table of contents and required documentation for extended warranties.
- ☐ Factory Testing documented and submitted for record.
- ☐ Record drawings submitted per specifications.
- ☐ Temperature Control record documents provided per specifications.

PART 2 - PRODUCTS – NOT USED

PART 3 - EXECUTION

3.1 EQUIPMENT STARTUP AND TESTING

A. Prior to completion and punchlist by the engineer, the contractor shall startup and test each piece of equipment as required by the specifications. The contractor shall provide documentation of all required tests with signoff of by the appropriate individual (engineer, architect, and building official).

3.2 LIFE SAFETY SYSTEMS

A. All life safety systems shall be fully and successfully tested by the contractor before being witnessed by the engineer or building official

B. The contractor shall provide a detailed test procedure, with instrumentation to be used, for approval by the engineer and building official prior to any testing.

C. Once tested by the contractor and fully operational, the systems shall be demonstrated to the engineer. Once accepted by the engineer the system shall be demonstrated to the building and fire officials.

3.3 COORDINATION WITH OTHERS

A. The Division 21 through 23 contractor shall coordinate their requirements with the General Contractor to ensure the other building systems are completed to the point that they will not adversely affect the operation of the Division 21 through 23 systems.

3.4 PUNCH LISTS

A. The contractor shall submit in writing that the project is ready for final review by the engineer.

B. Once the project is ready for final review the engineer will create a punch list of any corrections or deficiencies.

C. The contractor shall complete all punch list items and provide a letter to the architect after completion stating all items have been completed or reasons why they were not completed.

D. Upon receipt of this letter the engineer will verify that the punch list has been satisfactorily completed.

END OF SECTION

PROJECT MANUAL FOR CONSTRUCTION OF

SUPREME COURT OF MARYLAND

Rowe Boulevard
Annapolis, MD
Anne Arundel County
DGS Project #BA-688-200-001
Project Classification H

PROJECT SPECIFICATIONS

Volume 3 of 4: Divisions 26 - 28

Issue for Bid
December 1, 2023

DEPARTMENT OF GENERAL SERVICES
Atif Chaudhry, Secretary
301 West Preston Street, Room 1405
Baltimore, MD 21201

Board of Public Works
Wes Moore, Governor
Brooke Elizabeth Lierman, Comptroller
Dereck E. Davis, Treasurer

Maryland
DEPARTMENT OF GENERAL SERVICES

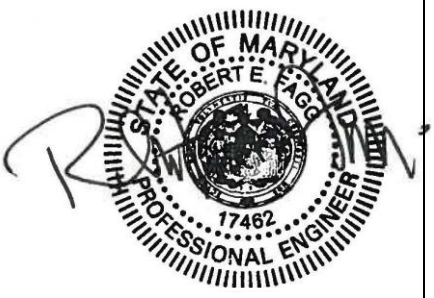
SUPREME COURT OF MARYLAND

FENTRESS ARCHITECTS

"Minority Business Enterprises are encouraged to respond to this solicitation."

This page is intentionally left blank.

SECTION 00 01 07 - SEALS PAGE

		
ARCHITECT OF RECORD	CIVIL ENGINEER	STRUCTURAL ENGINEER
 12/1/2023	 12/1/2023	 12/1/2023
FIRE PROTECTION	PLUMBING ENGINEER	MECHANICAL ENGINEER
 12/1/2023	 12/1/2023	
ELECTRICAL ENGINEER	TECHNOLOGY & AV ENGINEER	LANDSCAPE ARCHITECT

END OF SEALS PAGE

This page is intentionally left blank.

SECTION 00 01 10 - TABLE OF CONTENTS

Issue No.	**Issue Title**	**Issue Date**
Issue 1:	Issue for Bid	December 1, 2023

Legend:
X = First Issue for Bid
O = Reissue (unchanged)
R = Revised for this Package
W = Withdrawn
-- = Not Reissued for this Package

SECTION NUMBER	SECTION TITLE	Author	ISSUE NUMBER							
			1	2	3	4	5	6	7	8
DIVISION 00 - PROCUREMENT AND CONTRACTING REQUIREMENTS										
00 01 07	Seals Page	FA	X							
00 01 10	Table of Contents	FA	X							
DIVISION 00 – PROCUREMENT AND CONTRACTING REQUIREMENTS										
Division 00	Procurement and Contracting Requirements	DGS	X							
DIVISION 01 - GENERAL REQUIREMENTS										
01 10 00	Summary	FA	X							
01 21 00	Allowances	FA	X							
01 22 00	Unit Prices	FA	X							
01 23 00	Alternates	FA	X							
01 25 00	Substitution Procedures	FA	X							
01 26 00	Contract Modification Procedures	FA	X							
01 29 00	Payment Procedures	FA	X							
01 31 00	Project Management and Coordination	FA	X							
01 31 00A	Digital Data Licensing and Indemnification Exhibit – Appendix A	FA	X							
01 32 00	Construction Progress Documentation	FA	X							

SECTION NUMBER	SECTION TITLE	Author	ISSUE NUMBER							
			1	2	3	4	5	6	7	8
01 33 00	Submittal Procedures	FA	X							
01 40 00	Quality Requirements	FA	X							
01 42 00	References	FA	X							
01 43 39	Mockups	FA	X							
01 50 00	Temporary Facilities and Controls	FA	X							
01 50 10	Temporary Facilities and Controls - State Field Office	FA	X							
01 56 39	Temporary Tree and Plant Protection	AMT	X							
01 60 00	Product Requirements	FA	X							
01 73 00	Execution	FA	X							
01 74 19	Construction Waste Management and Disposal	FA	X							
01 74 19 EVA	Form CWM-1: Construction Waste Identification	FA	X							
01 74 19 EVB	Form CWM-2: Demolition Waste Identification	FA	X							
01 74 19 EVC	Form CWM-3: Construction Waste Reduction Work Plan	FA	X							
01 74 19 EVD	Form CWM-4: Demolition Waste Reduction Work Plan	FA	X							
01 74 19 EVE	Form CWM-5: Cost/Revenue Analysis of Construction Waste Reduction Work Plan	FA	X							
01 74 19 EVF	Form CWM-6: Cost/Revenue Analysis of Demolition Waste Reduction Work Plan	FA	X							
01 74 19 EVG	Form CWM-7: Construction Waste Reduction Progress Report	FA	X							
01 74 19 EVH	Form CWM-8: Demolition Waste Reduction Progress Report	FA	X							
01 77 00	Closeout Procedures	FA	X							
01 78 23	Operation and Maintenance Data	FA	X							
01 78 39	Project Record Documents	FA	X							
01 79 00	Demonstration and Training	FA	X							
01 81 13.14	Sustainable Design Requirements – LEED v4 BD+C, New Construction	FA	X							
01 81 13.14A	LEED Matrix - Appendix A	FA	X							

SECTION NUMBER	SECTION TITLE	Author	ISSUE NUMBER							
			1	2	3	4	5	6	7	8
01 81 13.14B	LEED Scorecard - Appendix B	FA	X							
01 81 13.14C	LEEDv4.1 Materials Submittal Form - Appendix C	FA	X							
01 91 13	General Commissioning Requirements [to be provided at later date]	DGS								
DIVISION 02 – EXISTING CONDITIONS										
02 41 19	Selective Demolition	FA	X							
DIVISION 03 – CONCRETE										
03 10 00	Concrete Forming and Accessories	HFA	X							
03 30 00	Cast-in-Place Concrete	HFA	X							
03 45 00	Precast Architectural Concrete	FA	X							
DIVISION 04 – MASONRY										
04 01 40.99	Relocation Reuse and Restoration of Latrobe Marble Columns	FA	X							
04 22 00	Concrete Unit Masonry	FA	X							
DIVISION 05 – METALS										
05 05 19	Post Installed Anchors	HFA	X							
05 12 00	Structural Steel Framing	HFA	X							
05 31 00	Steel Decking	HFA	X							
05 40 00	Cold-Formed Metal Framing	FA	X							
05 50 00	Metal Fabrications	FA	X							
05 51 13	Metal Pan Stairs	FA	X							
05 51 19	Metal Grating Stairs	FA	X							
05 52 13	Pipe and Tube Railings	FA	X							

SECTION NUMBER	SECTION TITLE	Author	ISSUE NUMBER							
			1	2	3	4	5	6	7	8
05 53 13	Bar Gratings	HFA	X							
05 58 13	Column Covers	FA	X							
05 70 00	Decorative Metal	FA	X							
05 71 00	Decorative Metal Stairs	FA	X							
05 73 00	Decorative Metal Railings	FA	X							
05 73 13	Glazed Decorative Metal Railings	FA	X							
05 75 00	Decorative Formed Metal	FA	X							
DIVISION 06 – WOOD, PLASTICS, AND COMPOSITES										
06 01 40.99	Relocation, Reuse, and Restoration of Historic Courtroom Woodwork	FA	X							
06 10 00	Rough Carpentry	FA	X							
06 16 00	Sheathing	FA	X							
06 40 23	Interior Architectural Woodwork	FA	X							
06 41 13	Wood-Veneer-Faced Architectural Cabinets	FA	X							
06 41 16	Plastic-Laminate-Clad Architectural Cabinets	FA	X							
06 42 14	Stile and Rail Wood Paneling	FA	X							
06 44 00	Ornamental Woodwork	FA	X							
06 64 00	Plastic Paneling	FA	X							
06 83 13	Fiber-Reinforced Plastic Paneling	FA	X							
DIVISION 07 – THERMAL AND MOISTURE PROTECTION										
07 05 43.13	Rainscreen Cladding Support Systems	FA	X							
07 11 13	Bituminous Dampproofing	FA	X							
07 13 26	Self-Adhering Sheet Waterproofing	FA	X							
07 14 13	Hot Fluid-Applied Rubberized Asphalt Waterproofing	FA	X							

SECTION NUMBER	SECTION TITLE	Author	ISSUE NUMBER							
			1	2	3	4	5	6	7	8
07 16 16	Crystalline Waterproofing	FA	X							
07 18 00	Traffic Coatings	FA	X							
07 19 00	Water Repellents	FA	X							
07 21 00	Thermal Insulation	FA	X							
07 21 19	Foamed-In-Place Insulation	FA	X							
07 27 13	Modified Bituminous Sheet Air Barriers	FA	X							
07 42 13.13	Formed Metal Wall Panels	FA	X							
07 54 19	Polyvinyl-Chloride (PVC) Roofing	FA	X							
07 62 00	Sheet Metal Flashing and Trim	FA	X							
07 72 00	Roof Accessories	FA	X							
07 72 73	Vegetated Roof Systems	FA	X							
07 81 00	Applied Fire Protection	FA	X							
07 84 13	Penetration Firestopping	FA	X							
07 84 43	Joint Firestopping	FA	X							
07 92 00	Joint Sealants	FA	X							
07 92 19	Acoustical Joint Sealants	FA	X							
DIVISION 08 – OPENINGS										
08 11 13	Hollow Metal Doors and Frames	FA	X							
08 14 16	Flush Wood Doors	FA	X							
08 14 33	Stile and Rail Wood Doors	FA	X							
08 31 13	Access Doors and Frames	FA	X							
08 33 23	Overhead Coiling Doors	FA	X							
08 33 43	Overhead Coiling Smoke Curtains	FA	X							
08 41 26.23	Interior All-Glass Entrances	FA	X							

SECTION NUMBER	SECTION TITLE	Author	ISSUE NUMBER							
			1	2	3	4	5	6	7	8
08 44 13	Glazed Aluminum Curtain Walls	FA	X							
08 56 53	Security Windows	FA	X							
08 63 00	Metal-Framed Skylights	FA	X							
08 71 00	Door Hardware	DMK/FA	X							
08 71 13	Power Door Operators	FA	X							
08 75 16	Window Operators	FA	X							
08 80 00	Glazing	FA	X							
08 81 13	Decorative Glass Glazing	FA	X							
08 83 00	Mirrors	FA	X							
08 88 53	Security Glazing	FA	X							
08 91 19	Fixed Louvers	FA	X							
DIVISION 09 – FINISHES										
09 05 61.13	Moisture Vapor Emission Control	FA	X							
09 21 16.23	Gypsum Board Shaft Wall Assemblies	FA	X							
09 22 16	Non-Structural Metal Framing	FA	X							
09 23 13	Acoustical Gypsum Plastering	FA	X							
09 24 00	Cement Plastering	FA	X							
09 27 13	Glass-Fiber-Reinforced Gypsum Fabrications	FA	X							
09 29 00	Gypsum Board	FA	X							
09 30 13	Ceramic Tiling	FA	X							
09 51 13	Acoustical Panel Ceilings	FA	X							
09 64 00	Wood Flooring	FA	X							
09 65 13	Resilient Base and Accessories	FA	X							
09 65 19	Resilient Tile Flooring	FA	X							

SECTION NUMBER	SECTION TITLE	Author	ISSUE NUMBER							
			1	2	3	4	5	6	7	8
09 65 36	Static-Control Resilient Flooring	FA	X							
09 65 66	Resilient Athletic Flooring	FA	X							
09 66 23	Resinous Matrix Terrazzo Flooring	FA	X							
09 68 13	Tile Carpeting	FA	X							
09 75 13	Stone Wall Facing	FA	X							
09 75 23	Simulated Stone Wall Facing	FA	X							
09 84 33	Sound-Absorbing Wall Units	FA	X							
09 91 23	Interior Painting	FA	X							
09 96 11	High-Performance Coatings (Proprietary Specification)	FA	X							
DIVISION 10 – SPECIALTIES										
10 12 00	Display Cases	FA	X							
10 14 00	Signage	FA	X							
10 21 13.17	Phenolic-Core Toilet Compartments	FA	X							
10 22 13	Wire Mesh Partitions	FA	X							
10 22 39	Folding Panel Partitions	FA	X							
10 26 00	Wall and Door Protection	FA	X							
10 26 41	Bullet Resistant Panels	FA	X							
10 28 00	Toilet, Bath, and Laundry Accessories	FA	X							
10 43 13	Defibrillator Cabinets	FA	X							
10 44 13	Fire Protection Cabinets	FA	X							
10 44 16	Fire Extinguishers	FA	X							
10 45 13	Photoluminescent Egress Path Markings	FA	X							
10 51 13	Metal Lockers	FA	X							
10 51 16	Wood Lockers	FA	X							

SECTION NUMBER	SECTION TITLE	Author	ISSUE NUMBER							
			1	2	3	4	5	6	7	8
10 51 23	Plastic-Laminate-Clad Lockers	FA	X							
10 56 26	Mobile Storage Shelving	FA	X							
10 81 13	Bird Control Devices	FA	X							
DIVISION 11 – EQUIPMENT										
11 12 00	Vehicle Access Control Systems	M2H	X							
11 13 19	Stationary Loading Dock Equipment	FA	X							
11 19 16	Detention Gun Lockers	FA	X							
11 30 13	Residential Appliances	FA	X							
11 81 31	Facility Fall Protection and Facade Access Equipment	FA	X							
11 81 33	Mobile Scissor Lifts	FA	X							
DIVISION 12 – FURNISHINGS										
12 24 13	Roller Window Shades	FA	X							
12 36 23.13	Plastic-Laminate-Clad Countertops	FA	X							
12 36 61.19	Quartz Agglomerate Countertops	FA	X							
12 93 00	Site Furnishings	RHI	X							
DIVISION 14 – CONVEYING EQUIPMENT										
14 21 23.16	Machine Room-Less Electric Traction Passenger Elevators	FA	X							
14 27 00	Custom Elevator Cabs and Doors	FA	X							
DIVISION 21 – FIRE SUPPRESSION										
21 05 00	Common Work Results For Fire Suppression	ME-E	X							
21 08 00	Commissioning Of Fire Suppression System	ME-E	X							

SECTION NUMBER	SECTION TITLE	Author	ISSUE NUMBER							
			1	2	3	4	5	6	7	8
21 13 00	Fire Suppression Sprinkler Systems	ME-E	X							
21 13 19	Preaction Suppression Systems	ME-E	X							
21 90 00	Fire Suppression System Project Closeout	ME-E	X							
DIVISION 22 – PLUMBING										
22 00 00	Basic Plumbing Requirements	WFT	X							
22 05 13	Common Motor Requirements for Plumbing Equipment	WFT	X							
22 05 16	Expansion Fittings and Loops for Plumbing Piping	WFT	X							
22 05 17	Sleeves and Sleeve Seals for Plumbing Piping	WFT	X							
22 05 18	Escutcheons for Plumbing Piping	WFT	X							
22 05 19	Meters and Gages for Plumbing Piping	WFT	X							
22 05 23.12	Ball Valves for Plumbing Piping	WFT	X							
22 05 23.13	Butterfly Valves for Plumbing Piping	WFT	X							
22 05 23.14	Check Valves for Plumbing Piping	WFT	X							
22 05 23.15	Gate Valves for Plumbing Piping	WFT	X							
22 05 29	Hangers and Supports for Plumbing Piping and Equipment	WFT	X							
22 05 48.13	Vibration Controls for Plumbing Piping and Equipment	WFT	X							
22 05 53	Identification for Plumbing Piping and Equipment	WFT	X							
22 05 93	Testing, Adjusting, and Balancing for Plumbing	WFT	X							
22 07 16	Plumbing Equipment Insulation	WFT	X							
22 07 19	Plumbing Piping Insulation	WFT	X							
22 11 16	Domestic Water Piping	WFT	X							
22 11 19	Domestic Water Piping Specialties	WFT	X							
22 11 23.13	Domestic Water Packaged Booster Pumps	WFT	X							
22 11 23.21	Inline, Domestic-Water Pumps	WFT	X							

SECTION NUMBER	SECTION TITLE	Author	ISSUE NUMBER							
			1	2	3	4	5	6	7	8
22 12 23.11	Facility Indoor Potable Water Storage Tanks	WFT	X							
22 13 13	Facility Sanitary Sewers	AMT	X							
22 13 16	Sanitary Waste and Vent Piping	WFT	X							
22 13 19	Sanitary Waste Piping Specialties	WFT	X							
22 13 19.13	Sanitary Drains	WFT	X							
22 13 23	Sanitary Waste Interceptors	WFT	X							
22 14 13	Facility Storm Drainage Piping	WFT	X							
22 14 23	Storm Drainage Piping Specialties	WFT	X							
22 14 29	Sump Pumps	WFT	X							
22 32 00	Domestic Water Filtration Equipment	WFT	X							
22 33 00	Electric, Domestic-Water Heaters	WFT	X							
22 42 13.13	Commercial Water Closets	WFT	X							
22 42 13.16	Commercial Urinals	WFT	X							
22 42 16.13	Commercial Lavatories	WFT	X							
22 42 16.16	Commercial Sinks	WFT	X							
22 42 23	Commercial Showers	WFT	X							
22 45 00	Emergency Plumbing Fixtures	WFT	X							
22 47 16	Pressure Water Coolers	WFT	X							
DIVISION 23 – HEATING, VENTILATING, AND AIR CONDITIONING (HVAC) *Refer To Alternates List For Applicable Sections										
23 05 01*	Mechanical and Electrical Coordination 23 05 01 and 26 05 01	ME-E	X							
23 05 02	Basic Mechanical Requirements	ME-E	X							
23 05 03	Basic Mechanical Materials and Methods	ME-E	X							
23 05 04	Corrosion Protection from Humid Salt-Laden Outdoor Air	ME-E	X							
23 05 13	Motors and Starters	ME-E	X							

SECTION NUMBER	SECTION TITLE	Author	ISSUE NUMBER							
			1	2	3	4	5	6	7	8
23 05 21	Pipe and Pipe Fittings	ME-E	X							
23 05 22	Piping Accessories	ME-E	X							
23 05 23	Valves	ME-E	X							
23 05 29	Pipe Supports and Anchors	ME-E	X							
23 05 30	Electronic Speed Controllers	ME-E	X							
23 05 48	Vibration Control	ME-E	X							
23 05 53	Mechanical Identification	ME-E	X							
23 05 93	Test-Adjust-Balance	ME-E	X							
23 07 00	Mechanical Insulation	ME-E	X							
23 08 00	Building Mechanical System Commissioning	ME-E	X							
23 08 01	Commissioning Agent Requirements	ME-E	X							
23 09 00	Building Automation and Automatic Temperature Control Systems	ME-E	X							
23 09 02	Life Safety Systems	ME-E	X							
23 09 03*	Smoke Management 23 09 03 and 28 46 10	ME-E	X							
23 21 13	Hydronic Piping	ME-E	X							
23 21 23	HVAC Pumps	ME-E	X							
23 23 00	Refrigerant Piping	ME-E	X							
23 25 13	HVAC System Chemical Treatment	ME-E	X							
23 31 13	Ductwork	ME-E	X							
23 33 00	Ductwork Accessories	ME-E	X							
23 34 00	Fans	ME-E	X							
23 36 00	Air Terminal Units	ME-E	X							
23 37 00	Air Inlets and Outlets	ME-E	X							
23 40 00	Air Cleaning	ME-E	X							
23 52 00	Boilers	ME-E	X							

SECTION NUMBER	SECTION TITLE	Author	ISSUE NUMBER							
			1	2	3	4	5	6	7	8
23 64 23	Air Cooled Scroll Heat Pump Water Chillers	ME-E	X							
23 73 13	Air Handling Units with Coil	ME-E	X							
23 73 24	Split System Dx Air Handling Units	ME-E	X							
23 81 23	Electronic Room Air Conditioning Unit	ME-E	X							
23 81 26	Split System Air Conditioners	ME-E	X							
23 81 29	Variable Refrigerant Flow HVAC Systems	ME-E	X							
23 82 16	Air Coils	ME-E	X							
23 82 19	Fan Coil Units	ME-E	X							
23 82 39	Heating Terminal Units	ME-E	X							
23 84 13	Humidifiers	ME-E	X							
23 90 00	Project Closeout	ME-E	X							
DIVISION 26 – ELECTRICAL *Refer To Alternates List For Applicable Sections										
26 05 00	Electrical Requirements	ME-E	X							
26 05 01*	Mechanical and Electrical Coordination 23 05 01 and 26 05 01	ME-E	X							
26 05 02	Basic Material and Methods	ME-E	X							
26 05 03	Manufacturers	ME-E	X							
26 05 10	Testing	ME-E	X							
26 05 19	Electrical Power Conductors and Cables	ME-E	X							
26 05 26	Grounding and Bonding	ME-E	X							
26 05 29	Hangers and Supports	ME-E	X							
26 05 33	Raceways and Boxes	ME-E	X							
26 05 43	Underground Ducts, Raceways and Manholes	ME-E	X							
26 05 48	Vibration and Seismic Controls	ME-E	X							

SECTION NUMBER	SECTION TITLE	Author	ISSUE NUMBER							
			1	2	3	4	5	6	7	8
26 05 53	Identification	ME-E	X							
26 05 73	Electrical Studies	ME-E	X							
26 09 13	Electrical Power Monitoring	ME-E	X							
26 09 36	Modular Dimming Controls	MCLA	X							
26 09 43	Lighting Control System	ME-E	X							
26 22 13	Low-Voltage Distribution Transformers	ME-E	X							
26 24 12	Utility Service Connection Cabinets	ME-E	X							
26 24 13	Distribution Switchboards	ME-E	X							
26 24 16	Panelboards	ME-E	X							
26 25 00	Enclosed Bus Assemblies	ME-E	X							
26 27 26	Wiring Devices	ME-E	X							
26 27 29	Electric Vehicle Charging Systems	ME-E	X							
26 28 16	Enclosed Switches, Fuses and Circuit Breakers	ME-E	X							
26 32 13	Diesel-Engine Driven Generator Sets	ME-E	X							
26 36 23	Automatic Transfer Switches	ME-E	X							
26 41 13	Lightning Protection for Structures	ME-E	X							
26 43 13	Surge Protective Device (SPD) (Selenium Enhanced)	ME-E	X							
26 43 14	Surge Protective Device (SPD)	ME-E	X							
26 51 00	Lighting Fixtures	MCLA	X							
26 56 13	Poles and Standards	ME-E	X							
26 90 00	Project Closeout	ME-E	X							
DIVISION 27 – COMMUNICATIONS										
27 05 00	Common Work Results for Communications	ME-E	X							
27 05 26	Telecommunications Grounding and Bonding	ME-E	X							

SECTION NUMBER	SECTION TITLE	Author	ISSUE NUMBER							
			1	2	3	4	5	6	7	8
27 05 33	Telecommunications Raceways and Boxes	ME-E	X							
27 05 36	Cable Trays	ME-E	X							
27 11 00	Communications Equipment Room Fit-Out	ME-E	X							
27 13 13	Communications Copper Backbone Cabling	ME-E	X							
27 13 23	Communications Optical Fiber Backbone Cabling	ME-E	X							
27 15 00	Communications Horizontal Cabling	ME-E	X							
27 41 00	Audio Visual Systems	ME-E	X							
27 53 20	Distributed Antenna Systems (DAS) General Requirements	ME-E	X							
DIVISION 28 – ELECTRONIC SAFETY AND SECURITY *Refer To Alternates List For Applicable Sections										
28 05 00.10	Common Work Results for Electronic Security	M2H	X							
28 05 09.10	Surge Protection for Electronic Security	M2H	X							
28 05 11	Cyber Security for Electronic Security	M2H	X							
28 05 13	Conductors and Cables for Electronic Security	M2H	X							
28 05 13.10	Servers, Workstations, and Storage for Electronic Security	M2H	X							
28 05 26.10	Grounding and Bonding for Electronic Security	M2H	X							
28 05 28.10	Pathways for Electronic Security	M2H	X							
28 05 29	Hangers and Supports for Communications Systems	M2H	X							
28 05 31.10	Communications Equipment for Electronic Security	M2H	X							
28 05 43	Underground Pathways for Elect Security	M2H	X							
28 05 44	Sleeves and Sleeve Seals for Electronic Security Pathways and Cabling	M2H	X							
28 08 00.10	Commissioning of Electronic Security	M2H	X							
28 11 16	Security Racks, Frames, and Enclosures	M2H	X							
28 13 00	Physical Access Control System	M2H	X							

SECTION NUMBER	SECTION TITLE	Author	ISSUE NUMBER							
			1	2	3	4	5	6	7	8
28 13 23	Optical Fiber Backbone Cabling for Electronic Security	M2H	X							
28 15 13	Security Copper Horizontal Cabling	M2H	X							
28 15 23	Intercom and Public Address Systems	M2H	X							
28 16 00	Intrusion Detection System	M2H	X							
28 23 00	Video Surveillance System	M2H	X							
28 46 00	Addressable Fire Alarm System	ME-E	X							
28 46 10*	Smoke Management 23 09 03 and 28 46 10	ME-E	X							
28 50 10	Area of Rescue Assistance System	ME-E	X							
28 50 20	Emergency Responder Radio System	ME-E	X							
28 51 00	Information Management & Presentation	M2H	X							
DIVISION 31 – EARTHWORK										
31 10 00	Site Clearing	AMT	X							
31 20 00	Earth Moving	AMT	X							
DIVISION 32 – EXTERIOR IMPROVEMENTS										
32 12 16	Asphalt Paving	AMT	X							
32 13 13	Concrete Paving	AMT	X							
32 13 13.33	Concrete Paving for Sidewalks	RHI	X							
32 13 73	Concrete Paving Joint Sealants	AMT	X							
32 13 73.33	Concrete Paving Joint Sealants for Sidewalks	RHI	X							
32 14 00	Unit Paving	FA	X							
32 17 13	Parking Bumpers	FA	X							
32 17 23	Pavement Markings	AMT	X							
32 17 26	Tactile Warning Surfacing	AMT	X							

SECTION NUMBER	SECTION TITLE	Author	ISSUE NUMBER							
			1	2	3	4	5	6	7	8
32 31 19	Decorative Metal Gates	FA	X							
32 91 15	Soil Preparation	RHI	X							
32 92 00	Lawns and Turfgrasses	RHI	X							
32 93 00	Exterior Plants	RHI	X							
32 96 00	Transplanting	RHI	X							
DIVISION 33 – UTILITIES										
33 14 15	Site Water Distribution Piping	AMT	X							
33 41 99	Stormwater Management	AMT	X							
33 42 00	Stormwater Conveyance	AMT	X							

END OF TABLE OF CONTENTS

SECTION 26 05 00 - ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. This Section supplements Division 1, General Requirements.

B. Where contradictions occur between this Section and Division 1, the more stringent of the two shall apply. Architect shall decide which is most stringent.

C. Provisions of Divisions 21, 22, 23, 27 and 28 shall also apply to the work of this section as if fully repeated here.

D. Provision indicate Section 23 05 01/26 05 01 “Mechanical and Electrical Coordination” shall also apply to the work of this section as if fully repeated here.

1.2 REGULATORY REQUIREMENTS

A. All materials shall conform to the current applicable industry standards. Workmanship and neat appearance shall be as important as electrical and mechanical operation. Defective or damaged materials shall be replaced or repaired prior to final acceptance in a manner meeting approval of the Architect and at no additional cost to the Owner.

B. The latest editions of the following standards are minimum requirements.

1. Underwriters’ Laboratories, Inc. (UL)
2. National Electrical Manufacturer’s Assoc. (NEMA)
3. American National Standards Institute (ANSI)
4. Institute of Electrical and Electronic Engineers (IEEE)
5. International Electrical Testing Association (NETA)
6. Insulated Cable Engineer’s Association (ICEA)

C. All work and materials shall comply with latest rules, codes and regulations including, but not limited to the following:

1. OSHA.
2. National Fire Codes of National Fire Protection Assoc. (NFPA)
3. National Electrical Safety Code (NESC, ANSI C2)
4. National Electrical Code (2011 Edition) with city, county and state Amendments.
5. International Building Code (2018 Edition) with city, county and state Amendments.
6. 2010 ADAAG Americans with Disabilities Accessibility Guidelines.
7. All applicable Federal, state and local laws, code amendments and regulations.

D. Code compliance is mandatory. Nothing in these drawings and specifications permits work not conforming to these codes.

E. No work shall be concealed until after inspection and approval by proper authorities. If work is concealed without inspection and approval, Contractor shall be responsible for all work required to open and restore the concealed area including all required modifications.

F. Contradictions: Where Codes are contradictory, follow the most stringent. Architect/Engineer shall determine which is most stringent.

1.3 CONTRACT DOCUMENTS

A. Drawings indicate general arrangement of circuits and locations of outlets, conduit, and other work. Information shown on drawings is as accurate as planning can determine, but not guaranteed and field verification of all dimensions, locations, levels, etc., to suit field conditions is directed. Review all architectural, structural and mechanical drawings, and adjust all work to conform to all conditions shown therein. Architectural drawings shall take precedence over all other drawings. Discrepancies between different drawings or between drawings and specifications or regulations and codes governing installation shall be brought to attention of the Architect.

B. Where the Drawings and Specifications do not comply with the minimum requirements of the Codes, either notify the Architect/Engineer in writing during the Bidding Period of the revisions required to meet Code requirements, or provide an installation which complies with the Code requirements. After entering into contract, Contractor will be held to complete all work necessary to meet these requirements without additional expense to the Owner.

C. Follow Drawings and Specifications where they are superior to Code requirements. The more stringent of plans and drawing shall apply.

1.4 COORDINATION DRAWINGS

A. Prepare coordination drawings in accordance with Division 1 “Submittals” to a scale of 1/4” = 1’-0” or larger; detailing major elements, components, and systems of electrical equipment (i.e., all transformer vaults, switchgear rooms, generator rooms, electrical rooms and technology rooms) and materials in relationship with other systems, installations, and building components. Where equipment is located outdoors, prepare shop drawings indicating electrical equipment locations and exterior elements in the equipment areas. Indicate locations where space is limited for installation and access and where sequencing and coordination of installations are important to the efficient flow of the work, including (but not necessarily limited to) the following:

Indicate the proposed locations of major raceway systems, and materials. Include the following:

a. Exterior wall and foundation penetrations.
b. Fire-rated wall and floor penetrations.
c. Support details.
d. Sizes and location of required concrete pads and bases.

2. Indicate scheduling, sequencing, movement, and positioning of large equipment into the building during construction.
3. Prepare floor plans, elevations, and details to indicate penetrations in floors, walls, and ceilings and their relationship to other penetrations and installation.
4. Electrical and Transformer Vault Rooms indicating conduit stub-up locations.
5. Normal and emergency underground conduit and duct bank routing.

1.5 RECORD DRAWINGS

A. Refer to Division 1 for additional requirements.

B. Maintain a blue-line set of Electrical Contract Drawings in clean, undamaged condition, for mark-up of installations which vary from the Contract Drawings. These drawings shall be a separate set of drawings, not used for construction purposes, and shall be kept up to date as the job progresses. This set shall be made available for inspection by the Engineer or Architect at all times. Upon completion of the contract a set of computerized “as builts” capable of interfacing with AutoCAD software, shall be delivered to the Architect.

C. Prepare record documents in accordance with the requirements in Division 1 Section “Project Closeout.” In addition to the requirements specified in Division 1, indicate installed conditions for:

1. Major raceway systems, size and location, for both exterior and interior and locations of handholes and conduit stub-up locations.
2. Panelboard circuit directories reflecting all field changes.
3. Approved substitutions, Contract Modifications, and actual equipment and materials installed.
4. Results of all testing performed as specified in the specification.
5. Certification of inspection from Authorities Having Jurisdiction.

D. Record the locations and invert elevations of underground installations.

1.6 OPERATING AND MAINTENANCE MANUALS

A. Refer to Division 1 for additional requirements.

B. Submission:

1. Submit an electronic copy of Operating and Maintenance Manuals prior to scheduling systems demonstration for the Owner.

C. Requirement Contents:

1. Manuals shall have either a combined file with bookmarks for each section or individual file for each section. If individual files, each digital file shall include section number and title in the file name.
2. Submittal for each section shall identify all equipment and materials installed on the project.
3. Manual to include contact information for a local supplier that can provide the specific piece of equipment.
4. Provide certificates for such items of equipment which have warranties in excess of one year.
5. Provide test results for each specification section identified herein.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to the project properly identified with names, model numbers, types, grades, compliance labels, and other information needed for identification.

B. Protection of Equipment:

1. All electrical equipment to be used in the construction shall be properly stored and protected against the elements. All equipment shall be stored under cover, and shall not be stored at the construction site on the ground, in mud, water, rain, sleet, or dust. Large diameter cables may be stored on reels outside; however, all cable ends shall be waterproofed and the reels covered with weatherproof materials. Such weatherproof materials shall be heavy-duty, securely fastened, and made impervious to the elements.
2. Conventional electrical construction materials such as building wire, outlet and junction boxes, wiring devices, conduit, lighting fixtures, fittings, etc., shall be stored in construction buildings, covered trailers, or portable covered warehouses. Any equipment subject to damage or corrosion from excessive moisture shall be stored in dry, heated areas. Any equipment containing plastic or material subject to damage caused by excessive heat or sunlight shall be stored to prevent such damage. This includes plastic ducts and lenses.
3. Equipment damaged as a result of the above conditions shall be properly repaired at the contractor’s expense or shall be replaced at the contractor’s expense, if in the opinion of the Engineer, the equipment has been damaged to such an extent that it cannot operate properly after repairs are made.
4. All electrical enclosures exposed to construction damaged such as paint spots, spackling or plaster spatter, grout splashes, waterproofing compound, tar spots or runs, and pipe covering compound splashes, shall be completely covered and protected against damage.
5. In the event leakage into the building of any foreign material or fluid occurs or may occur, the contractor shall take all steps as described above to protect any and all equipment.
6. After connections to electrical equipment are complete and the equipment is ready for operation, all construction debris shall be removed from all enclosures. Such debris includes dust, dirt, wire clippings, tape, and insulation removed in order to make the connection.

1.8 SAFETY AND INDEMNITY

A. The Contractor shall be solely and completely responsible for conditions of the job site, including safety of all persons and property during performance of the work. This requirement will apply continuously and not be limited to normal working hours. See also General Conditions.

B. No act, service, drawings review or construction review by the Architect or Engineer, is intended to include review of the adequacy of the Contractor’s safety measures in, on, or near the construction site.

1.9 WARRANTIES

A. The warranty period is generally one year after Date of Acceptance.

1. During this period, provide labor and materials as required to repair or replace defects in the electrical systems at no cost to the Owner. Provide certificate with O & M manual submittal which guarantees same day service response to the Owner's call for such warranty service.
2. Provide certificates for such items of equipment which have warranties in excess of one year. Insert copies of O & M manual. Such equipment shall include:

a. Emergency generator system including transfer switches and transformers
b. Major electrical switchgear and switchboard
c. Lighting fixtures
d. Lightning protection
e. Fire alarm system
f. Lighting control

3. Provide extended manufacturers warranties to cover one full year from Date of Acceptance if standard manufacturers' warranty ends any time prior to that date.

PART 2 - PRODUCTS

2.1 EQUIPMENT AND MATERIALS

A. All equipment and materials installed shall be new, unless otherwise specified.

B. All major equipment components shall have manufacturers' name, address, model number and serial number permanently attached in a conspicuous location.

C. All equipment shall be UL listed and bear the UL label.

D. Specifications list approved products for the project, if not listed follow substitution request process.

E. All areas directly exposed to outside air shall be considered exterior. Contractor's electrical installation, means and methods and materials used shall be appropriate for outdoor installations in these areas.

2.2 GENERAL SUBMITTAL REQUIREMENTS

A. Coordination and Sequencing:

1. After receipt of notice to proceed, the Contractor shall submit to the Architect a typed list of submittals and the scheduled date of submission. List shall include submittal number, section number and scheduled date of submission. Submittals shall be grouped and submitted in no more than ten complete packages.
2. The contractor shall not submit any shop drawings or product data that does not comply with the contract documents. Prior to submitting shop drawings, review submittal for compliance with Contract Documents and place a stamp or other confirmation thereon which states that submittals have been reviewed. Submittals without such verification will be returned disapproved without review.

3. Submittal is for information and record, unless otherwise indicated, and is not a change order request.

B. Preparation of Submittals:

1. Refer to Division 1 requirements.
2. The Contractor shall submit for approval by the Architect data of materials and equipment to be incorporated in the work. Submittals shall be supported by descriptive material, catalogs, cuts, diagrams, performance curves, and charts published by the manufacturer to show conformance to specification and drawing requirements; model numbers alone will not be acceptable. Provide complete electrical characteristics for all equipment. Submit product submittals on items as outlined in sections hereinafter.
3. Product submittals shall be made by specification section. All items of a section, requiring submission, shall be submitted together in one individual electronic file.
4. If two or more sections require inter-coordination (e.g., emergency generator and transfer switch; short circuit study, coordination study, electrical room layouts and electrical switchboards, fire alarm and fire command center layout), they shall be submitted at the same time. If electrical gear is submitted without electrical room layouts, short circuit study, coordination study, the submittal will be returned without review.
5. Each section shall be submitted as an individual file with section number and section name in the file name of the submittal.
6. Submittals of an entire product catalog will be rejected without review. Products to be used on the project must be indicated on cut sheets.
7. Provide cover letter in electronic file identifying project name, Contractor, Subcontractor, submittal name, date of submission, specification section, and information to distinguish it from other submittals.
8. Submittals not presented in individual electronic files or neat and legible fashion will returned “Without Action.”
9. Submittals shall show Contractor’s executed review and approval marking. Submittals which are received from sources other than through Contractor’s office will be returned “Without Action.”
10. Provide space for Architect’s “Action” marking.

C. Substitutions

1. Refer to the General Conditions, which govern “Substitution” of specified equipment or materials.
2. Indicate any portions of work which deviate from the Contract Documents.

    a. Explain the reasons for the deviations.
    b. Show how such deviations coordinate with interfacing portions of other work.

3. Where substitution of materials alters space requirements indicated on the drawings, submit shop drawings indicating proposed layout of space, all equipment to be installed therein and clearances between equipment (i.e., electrical rooms). All clearances required by the National Electrical Code and applicable state and local regulations must be maintained.

D. Review Process

1. The Architect reserves the right to require a sample of any equipment to be submitted for approval and to retain its possession.

2. Refer to the individual sections for identified equipment and material for which submittals are required. In addition, provide shop drawings and product data on the following equipment:

   Electrical Power Conductors and Cables
   Grounding and Bonding
   Hangers and Supports
   Raceway and Boxes
   Cable Trays
   Underground Duct, Raceway & Manholes
   Vibration and Seismic Controls
   Identification
   Lighting Control
   Low-Voltage Distribution Transformers
   Switchboards
   Panelboards
   Enclosed Bus Assemblies
   Wiring Devices
   Fuses
   Generator Sets
   Automatic Transfer Switches
   Lightning Protection for Structures
   Surge Protection Device
   Lighting Fixtures
   Poles and Standards
   Enclosed Switches and Circuit Breakers
   Fiber Optic Cabling
   Telecommunication Backbone Cabling
   Horizontal Cabling
   Fire Alarm System
   Area of Rescue System
   Emergency Responder Radio System

   Do not submit on equipment or materials not requested in the specifications.

3. Review of shop drawings and product data by the Architect/Engineer, including any review annotations or stamp notations, does not relieve the contractor from the required compliance with the contract documents.
4. The shop drawing and product data review stamp notation requirements are defined as follows:

   a. “NO EXCEPTION TAKEN:” The reviewer did not observe any items which were not in compliance with the contract documents. All dimensions, details, and coordination with other trades are the responsibility of the contractor.
   b. “MAKE CORRECTIONS NOTED:” The reviewer indicated items observed that were not in compliance with the contract documents. The contractor shall not resubmit, but shall make corrections and provide corrected documents with the “Record Drawings.”
   c. “REJECTED, REVISE AND RESUBMIT:” The reviewer indicated items observed which were not in compliance with the contract documents. The contractor shall resubmit showing corrections of all noted items. Delays for resubmittal do not relieve the contractor from meeting project schedules.
   d. “REJECTED:” The submission does not comply with the contract requirements. The entire submittal must be corrected and submitted for review. Delays for resubmittal do not relieve the contractor from meeting project schedules.

5. If shop drawings are submitted and returned as “NO EXCEPTION TAKEN” or “MAKE CORRECTIONS NOTED” and meet contract requirements, the contractor shall not resubmit any other shop drawings for these items.
6. If resubmittals are necessary, they shall be made as specified above for submittals. Resubmittals shall highlight all revisions made and cover shall include the phrase “RESUBMITTAL NO. _____.”
7. Resubmittal requirements do not entitle the Contractor to additional time and are not a cause for delay of the project.

PART 3 - EXECUTION

3.1 CONDITIONS AT SITE

A. Visit to site is required of all bidders prior to submission of bid. All bidders will be held to have familiarized themselves with all discernible conditions, and no extra payment will be allowed for work required because of these conditions, whether specifically mentioned or not.

B. Lines of other services and/or equipment that are damaged as a result of this work shall promptly be repaired at no expense to the Owner.

3.2 LICENSES, FEES AND PERMITS

A. Arrange for required inspections and pay all license, permit and inspection fees. Furnish a certificate of final inspections and approvals from local authority having jurisdiction over electrical installation.

3.3 WORKMANSHIP AND CONTRACTOR’S QUALIFICATIONS

A. Only professional quality workmanship will be accepted. Haphazard or poor installation practice will be cause for rejection of work.

B. Provide foreman in charge of this work at all times. Foremen for this work shall have had experience in installing not less than 5 such electrical systems of equal or greater complexity.

C. Where specifications call for an installation to be made in accordance with manufacturers’ recommendations, a copy of such recommendations shall at all times be kept in job superintendent’s office.

3.4 RELATION WITH OTHER TRADES

A. Contractor shall coordinate work of this Division with other trades to avoid conflict and to provide rough-ins and other connections for equipment furnished under other divisions that require electrical connections. Inform other trades of required clearances of accesses for or around electrical equipment to maintain serviceability and code compliance.

B. Verify equipment dimensions and rough-in requirements for Divisions 2 through 28 with provisions specified under this Section of work, and report discrepancies to the Architect in ample time to prevent delays or unwarranted changes of work.

3.5 TESTING

A. Provide all labor, materials, and equipment necessary to make required tests. Tests shall be complete and results approved before final inspection is begun.

3.6 PROGRESS OF WORK

A. Order progress of electrical work so as to conform to progress of work of other trades, and complete entire installation as soon as condition of building will permit. Assume any cost resulting from defective or ill-timed work performed under this Division.

3.7 CUTTING AND PATCHING

A. General: Perform cutting and patching in accordance with Division 1 Section “Cutting and Patching.” In addition to the requirement specified in Division 1, the following requirements apply:

1. Perform cutting, fitting, and patching of electrical equipment and materials required to:

a. Uncover work to provide for installation of ill-timed work.
b. Remove and replace defective work.
c. Remove and replace work not conforming to requirements of the Contract documents.
d. Remove samples of installed work as specified for testing.
e. Install equipment and materials in newly installed structures.
f. Upon written instructions from the architect, uncover and restore work to provide for Architect observation of concealed work.

3.8 SLEEVES

A. Place sleeve in forms of walls, floor slabs and partitions for passage of all conduits, pipes, and ducts installed under Divisions 26, 27 and 28. Sleeves shall be set in place a sufficient time ahead of concrete work so as not to delay that work. Install sleeves and raceways through exterior walls so as to provide a waterproof installation. All floor penetrations shall be made watertight. Conduits passing through walls shall be installed to preserve integrity of the wall rating (i.e., fire rating, sound rating, air, etc.). All penetration made through existing concrete slabs or walls shall be x-rayed and approved by Structural Engineer prior to cutting.

3.9 EXCAVATION, TRENCHING, AND BACKFILLING

A. Perform all excavation to install conduit and duct banks indicated on the drawings or specified herein. During excavation, pile material for backfilling back from the banks of the trench to avoid overloading and to prevent slides and cave-ins. Remove and dispose of all excavated materials not to be used for backfill. Grade to prevent surface water from flowing into trenches and excavation. Remove any water accumulating therein by pumping. Do all excavation by open cut. No tunneling shall be done unless indicated on the drawings or unless written permission is received from the Architect.

B. Grade the bottom of trenches to provide uniform bearing and support for conduits or duct bank on undisturbed soil at every point along its entire length. Tamp over depths with loose, granular, moist earth. Remove unstable soil that is not capable of supporting equipment or installation and replace with specified material for a minimum of 12” below invert of equipment or installation.

C. Backfill the trenches with excavated materials approved for backfilling, consisting of earth, loam, sandy clay, sand and gravel or soft shale. These materials should be free from large clods of earth and stones, deposited in 6” layers and rammed until the installation has cover of not less than the adjacent ground but not greater than 2” above existing ground. Backfilling shall be carried on simultaneously on both sides of the trench so that injurious pressures do not occur. Compaction of the filled trench shall be at least equal to that of the surrounding undisturbed material. Do not settle backfill with water. Reopen any trenches not meeting compaction requirements or where settlement occurs, refill, compact, and restore surface to grade and compaction indicated on the drawings, mounded over and smoothed off.

D. In addition, all excavation and backfilling shall comply with Division 2. The most stringent requirement shall apply.

3.10 CLEANUP

A. Remove all materials, scrap, etc., relative to electrical installations and leave premises in a clean, orderly condition. Any costs to the Owner for cleanup of site will be charged to the Contractor. At completion, all equipment, raceways, etc., shall be thoroughly cleaned and all residue removed from the inside and outside surfaces. Defaced finish shall be refinished.

3.11 TEMPORARY POWER

A. Provide temporary power as requested by the general contractor and in accordance with OSHA and local code requirements. Lighting and power outlets shall be provided throughout the project. Check with construction manager or general contractor prior to bid for special lighting and power outlets and provide as needed.

3.12 MINOR CHANGES

A. The Owner reserves the right to make minor changes in the locations of outlets and equipment up to the time of electrical rough-in without any cost to the Owner.

3.13 ELEVATOR COORDINATION

A. Provide control wiring and conduit from ATS to elevator controllers, as required by elevator vendor.

1. 2# 12-1”C from auxiliary contact (closed when switch in emergency position) on transfer switch to each elevator machine room which is served via that transfer switch. Terminate as and where required by the elevator vendor.
2. 2# 12-1”C from auxiliary contact (closed before switch returns to normal power) on transfer switch serving elevators to each elevator machine room which is served via that transfer switch. Terminate as and where required by the elevator vendor.

B. Provide 1” conduit from elevator controller to fire alarm control panel for elevator communication system, as required by elevator vendor.

3.14 ELECTRICAL SYSTEMS OPERATIONAL TESTS, CERTIFICATION, AND DESIGN AUTHORITY ASSISTANCE

A. Testing

1. Refer to the individual specification sections for test requirements.
2. Prior to the final inspection, the systems or equipment shall be tested and reported as herein specified. One electronic copy of the tests shall be submitted to the Architect/Engineer for approval.
3. All electrical systems shall be tested for compliance with the specifications.

B. Manufacturers’ Certifications

1. The electrical systems specified herein shall be reviewed for compliance with these specifications, installation in accordance with the manufacturers’ recommendations and system operation by a representative of the manufacturer. The manufacturer shall submit certification that the system has been installed in accordance with the manufacturers’ recommendations and is operating as specified in the contract documents.
2. Provide manufacturers’ certification for the emergency generator set/automatic transfer system, lighting control, fire alarm system and lightning protection.

C. Design Authority Assistance

1. The Contractor shall provide personnel to assist the Architect/Engineer or their representative during all construction review visits. The Contractor shall provide all necessary tools and equipment to demonstrate the system operation and provide access to equipment, including screwdrivers, wrenches, ladders, flashlights, circuit testing devices, meters, keys, etc.
2. Remove equipment covers (i.e., switchgears, switchboards, panelboard trims, panelboards, motor controls, device plates, and junction box covers) as directed for inspection of internal wiring. Accessible ceiling shall be removed as directed for inspection of equipment installed above ceilings. Reinstall all covers or ceilings after inspection.
3. Energize and de-energize circuits and equipment as directed. Demonstrate operation of equipment as directed by Architect/Engineer.
4. The Contractor shall provide authorized representatives of the manufacturers to demonstrate to the Architect/Engineer compliance with the specifications of their respective system during or prior to the final inspection at a time designated by the Architect. Refer to the appropriate specification section for additional testing requirements. Representatives of the emergency generator/automatic transfer switch and fire alarm systems are required for demonstrations.

3.15 COMMISSIONING

A. After startup and testing of each system has been completed, the Owner shall have an independent firm conduct detailed observations of the equipment and systems to confirm compliance with the Contract Documents.

B. The Division 26 Contractor shall include, as part of the work of his contract, costs to cover manpower, equipment, tools, ladders, instruments, etc., necessary to expedite the system performance observations.

C. The independent firm shall develop systems, equipment checkout procedures and data forms for recording compliance of the systems to the Contract Documents, performance, and construction observation lists, and will assist in developing schedules for checkout and Owner acceptance, at a future date during the construction phase.

END OF SECTION

SECTION 26 05 01 - MECHANICAL AND ELECTRICAL COORDINATION 23 05 01 AND 26 05 01

PART 1 - GENERAL

1.1 RESPONSIBILITY

A. The Divisions 21 through 23, 26 through 28 contractor(s) shall comply with the provisions of this section. The Divisions 21 through 23 contractor(s) shall verify electrical service provided by the electrical contractor before ordering any mechanical equipment requiring electrical connections. Provide submittals of all mechanical equipment to Division 26 through 28 contractor(s).

B. The final responsibility for properly coordinating the electrical work of this section shall belong to the Divisions 21 through 23 system contractor performing the work, which requires the electrical power.

1. Each Divisions 21 through 23 contractor shall be responsible for providing power wiring for certain devices as described in the specifications and on the drawings. This work shall be provided by a licensed electrician in accordance with all of the applicable provisions of the Division 26 through 28 specifications, NEC and local codes.

1.2 WORK INCLUDED

A. Carefully coordinate the interface between Divisions 21 through 23 (Mechanical) and Divisions 26 through 28 (Electrical), and Division 23 09 00 (Building Management and Automatic Temperature Control Systems) before submitting any equipment for review or commencing installation

1.3 DEFINITIONS

A. Automatic: Pertaining to a function, operation, process or device that, under specified conditions, functions without intervention by human operator.

B. Disconnect Switch: A mechanical switching device used for changing the connections in a circuit, or for isolating a circuit or equipment from a power source.

C. Motor Control Center: A floor-mounted assembly of one or more enclosed vertical sections having a common horizontal power bus and primarily containing motor starting units.

D. Control Circuit/Power: The circuit which carries the electrical signals of a control apparatus or system directing the performance of the controller but does not carry the main power circuit.

E. Manual Operation: Operation by hand without the use of any other power.

F. MC: Mechanical Contractor = Divisions 21 through 23 Contractor who furnishes motor.

G. TC: Temperature Controls = Division 23 09 00 Contractor who furnishes control.

H. EC: Electrical Contractor = Divisions 26 through 28 Contractor.

I. FA: Fire Alarm Contractor = Division 28 Contractor who furnishes Fire Alarm System.

1.4 RESPONSIBILITY SCHEDULE

A. Responsibility: Unless otherwise indicated, all motors and controls for Divisions 21 through 23 equipment shall be furnished, set in place and wired in accordance with the following schedule:

ITEM -	Furnished Under	Set In Place Under	Power Wiring Under	Control Wiring Under
MC: Mechanical Contractor TC: Temperature Contractor EC: Electrical Contractor FA: Fire Alarm Contractor				
AHU Interior Marine Lights	MC	MC	EC	MC
Equipment Motors	MC	MC	EC	--
Automatically or Manually Controlled Starters/Contactors: (Note 4) -Separate -Factory Mounted and Wired	 MC MC	 EC MC	 EC EC	 TC TC
In Motor Control Centers (Note 4)	EC	EC	EC	TC
Motor Speed Controllers: (Note 4) -Separate -Factory Mounted and Wired	 MC MC	 EC MC	 EC EC	 TC TC
Disconnect Switches (Note 1)	EC	EC	EC	--
Thermal Overload Switches (Note 1)	EC	EC	EC	--
Switches (Manual or Automatic other than disconnect) (Note 2)	MC or TC	MC or TC	EC or TC	TC or MC
Control Relays (Note 2)	MC or TC	MC or TC	--	TC
Control Transformers	MC or TC	MC or TC	EC or TC	TC
Push Button Stations, Pilot Lights	MC	EC	EC	EC
Thermostat and Controls: Integral with Equipment or Directly Attached to Ducts, Pipes, etc. (Note 2)	MC or TC	EC or TC	EC or TC	TC
Equipment in Temperature Control Panels	TC	TC	TC	TC
Standalone Control Panels (BAS) (Note 6)	TC	TC	TC	TC
Valve Motors, Damper Motors, Solenoid Valves, etc.	TC	TC	TC	TC
EP Valves or Switches, P.E. Switches, etc.	TC	TC	--	TC
Fire Alarm System (Note 3)	FA	FA	EC	FA
Fire Sprinkler Alarm (Note 3)	MC	MC	EC	FA
Duct System Smoke Detectors (Note 5)	FA	MC	--	TC/FA
Relays for Fan Control via duct detectors (Note 5)	MC	MC	EC	TC
Room Smoke Detectors Including Relays for Fan Control (Note 3)	FA	FA	--	FA
Smoke Management Controls (Note 8)	FA	FA	EC	FA
CO Sensors and Control Panels	TC	TC	TC	TC
Equipment Interlocks	TC	TC	--	TC
Fire/Smoke and Smoke Dampers (Note 7)	MC	MC	EC	FA
Smoke Control Dampers (for smoke management system)	MC	MC	EC	FA/TC

ITEM -	Furnished Under	Set In Place Under	Power Wiring Under	Control Wiring Under
MC: Mechanical Contractor TC: Temperature Contractor EC: Electrical Contractor FA: Fire Alarm Contractor				
Positive Indication Devices (i.e., current sensors, end switches, airflow sensors)	TC	TC	--	FA/TC
Heat Trace Systems (Note 9)	MC	MC	MC	MC
Boiler/Water Heater EPO Shut-off Switch and gas solenoid valve(s). (Note 10)	MC	MC	EC	EC

Notes:

1. If furnished as part of factory wired equipment furnished and set in place by MC, wiring, and connections by EC.
2. If float switches, line thermostats, P.E. switches, time switches, or other controls carry the FULL LOAD CURRENT to any motor, they shall be furnished by MC, but they shall be set in place and connected by EC, except that where such items are an integral part of the mechanical equipment, or directly attached to ducts, piping, or other mechanical equipment, they shall be furnished and set in place by MC and connected by EC. If they do not carry the FULL LOAD CURRENT to any motor, they shall be furnished, set in place and wired by TC contractor.
3. Pre-action system initiation signals (such as smoke detectors or general alarm conditions in a pre-action zone) shall be provided under Division 28.
4. Electrical contractor is responsible for wiring from starter to motor unless factory wired.
5. Temperature control contractor shall provide conduit and wire from auxiliary contact in motor starter to the detector so that the unit shuts down in all operating modes. Fire Alarm Contractor to wire from the detector to fire alarm panel.
6. Each division shall be fully responsible for any control panels as called for on the drawings or specifications.
7. Division 26 shall provide all power and control wiring to fire/smoke or smoke dampers. Division 23 and 26/28 shall provide parallel control wiring (with 28 fire alarm having priority signal) to dampers and equipment utilized in both normal and smoke control modes. Refer to Smoke Control and Fire Alarm Drawings and the Fire Alarm Matrix.

    a. Fire alarm system shall override automated building control system during smoke exhaust mode.
    b. TC wiring to fire/smoke or smoke dampers required only when damper also serves HVAC system.

8. FA wires to components necessary for the operation and monitoring of the Smoke Management System. TC wires to components utilized in the control and monitoring of the Automated Building Control System.
9. Mechanical contractor shall be responsible for fully functional heat trace system. Mechanical contractor shall engage a licensed electrician to install heat trace system. Where applicable, mechanical contractor shall engage temperature controls contractor to install control wiring to Division 23 09 00 system.
10. Electrical contractor to provide shunt trip breaker or contactor to remove power from the equipment.

B. Power Wiring by Divisions 21 through 23 : The electrical power for certain equipment provided under Divisions 21 through 23 has not been specifically indicated on the electrical drawings and must be provided by and field coordinated by the Divisions 21 through 23 trade requiring such power. Sufficient power for this purpose shall be furnished as “spare” dedicated circuit capacity in Division 26’s panelboards. All wiring, conduit and electrical devices downstream of the panelboards are the responsibility of the Divisions 21 through 23 trade requiring the power.

1. Such equipment is hereby defined as:

a. Electrical heat trace. Required heat trace locations, capacities and specification are shown on the plumbing and mechanical drawings (Division 22 and 23 work).
b. Fire protection air compressors, dry-pipe control panels and valves. Required connections are included in the Division 21 work, and will be shown by that contractor’s engineered system design drawings.

1) Pre-action system initiation signals (such as smoke detectors or general alarm conditions in a pre-action zone) shall be provided under Division 28 fire alarm work.
2) Division 21 shall provide pre-action control panel and interconnection between nearest suitable fire alarm panel and location of pre-action valve(s).
3) Division 28 shall provide interconnection between fire command center alarm panel (provided under Division 28) and remote communication fire alarm panel (provided under Division 28).

c. Infrared plumbing fixtures. Fixtures requiring power are shown on the plumbing drawings and schedules. Provide junction box and or receptacle as required by manufacturer.
d. Temperature control panels, control air compressors and line voltage power for 24v control transformers. Required connections are included in Division 23 09 00 and will be shown by that contractor’s control submittal drawings.
e. Condensate pumps. Provide power from associated unit or from nearby panelboard.

1.5 GENERAL REQUIREMENTS

A. Connections:

1. Connections to all controls directly attached to ducts, piping and mechanical equipment shall be made with flexible connections.

B. Starters:

1. Provide magnetic starters for all three phase motors and equipment complete with:

a. Control transformers.
b. 120V holding coils.
c. Integral hand-off-auto switch.
d. Auxiliary contacts required for system operation plus one (1) spare.
e. Refer to Section 23 05 13 Motors, Starters and Drives.

C. Remote Switches and Pushbutton Stations:

1. Provide remote switches and/or pushbutton stations required for manually operated equipment (if no automatic controls have been provided) complete with pilot lights of an approved type lighted by current from load side of starter.

D. Special Requirements:

1. Motors, starters and other electrical equipment installed in moist areas or areas of special conditions, such as explosion proof, shall be designed and approved for installation in such areas with appropriate enclosure.

E. Identification:

1. Provide identification of purpose for each switch and/or pushbutton station furnished. Identification may be either engraved plastic sign permanently mounted to wall below switch, or stamping on switch cover proper. All such identification signs and/or switch covers in finished areas shall match other hardware in the immediate area.

F. Control Voltage:

1. Maximum allowable control voltage 120V. Fully protect control circuit conductors in accordance with National Electrical Code.

G. DDC Control Interface:

1. Fully coordinate the requirements of each division with regard to supplying a complete DDC Control System prior to submitting bid.
2. All control power shall be furnished via dedicated line voltage circuits.
3. Dedicated control circuits from electrical panelboards to DDC control panels and from electrical panelboards to dedicated DDC J-boxes (for distributed control components such as VAV boxes), and control transformer line voltage connections shall be provided under Division 23 09 00 where required and as shown on the drawings.

    a. Exceptions: The following Divisions 21 through 23 equipment has been provided with electrical power feeders downstream of the panelboards by Division 26:

        1) Division 28 , Fire Alarm System Panels.
        2) Division 23 09 00 , Building Automation System (BAS):

            a) Each air handling unit (AHU) has been provided with a dedicated combination control and unit lighting circuit(s) to its air handling room.
            b) Certain BAS panels requiring emergency power.
            c) BAS workstations and file servers in the engineer’s office and fire command center.

        3) See the drawings for additional exceptions.

4. Low-voltage wiring from J-boxes to distributed control components, all low-voltage connections, all control panels and all control transformers (not part of unitary equipment) shall be provided under Division 23 09 00 .
5. Any additional power requirements shall be the responsibility of the Division 23 09 00 Contractor requiring same, and provided at no additional cost to the owner.

H. Short Circuit Current Ratings

1. MC shall be responsible for coordinating the Short Circuit Current Ratings (SCCR) of all such equipment with the electrical short circuit study. SCCR for equipment shall be greater than the available fault current, as indicated on electrical one-lines.
2. Utilizing fuses to limit the available fault current is not acceptable.

1.6 CEILING AND CHASE CAVITY PRECEDENCE

A. Coordinate ceiling cavity space carefully with all trades. In the event of conflict, install mechanical and electric systems within the cavity space allocation in the following order of precedence. A system with higher precedence may direct that systems of lower precedence be relocated from space, which is required for expedient routing of the precedent system.

1. Plumbing waste, cooling coil drain piping, and roof drain mains and leaders.
2. Plumbing vent piping.
3. Supply, return and exhaust ductwork.
4. Electrical conduit greater than 4” diameter.
5. Hydronic branch and mains.
6. Domestic water piping.
7. Fire sprinkler mains and leaders.
8. Hydronic branch piping (2” and less).
9. Domestic hot and cold-water branches.
10. Electrical conduit branch feeders.
11. Fire sprinkler branch piping and sprinkler runouts.

B. Light fixtures have precedence in a zone, which is the same height above the ceiling as the depth of the fixture (plus 2”).

C. Examine the contract documents of all trades (e.g. all Divisions 21 through 23 26 through 28 drawings, the architectural floor plans, reflected ceiling plans, elevations and sections, structural plans and sections, etc.).

D. Coordinate necessary equipment, ductwork and piping locations so that the final installation is compatible with the materials and equipment of the other trades.

E. Prepare shop drawings for installation of all new work before installation to verify coordination of work between trades.

F. Provide access doors for all equipment, valves, clean-outs, actuators and controls which require access for adjustment or servicing and which are located in otherwise inaccessible locations.

1. For equipment located in “accessible locations” such as lay-in ceilings: Locate equipment to provide adequate service clearance for normal maintenance without removing architectural, mechanical, electrical or structural elements such as the ceiling support system, electrical fixtures, etc. “Normal maintenance” includes, but is not limited to: filter changing; greasing of bearings; using p/t ports for pressure or temperature measurements; and replacement of ballasts, fuses, etc.

PART 2 - PRODUCTS

2.1 MOTOR HORSEPOWER

A. In general, all motors 1/2 HP and above shall be three phase, all motors less then 1/2 HP shall be single phase.

B. Voltage and phase of motors as scheduled on the electrical drawings shall take precedence in the case of a conflict between the mechanical and electrical drawings or general condition 2.1. A., above.

C. Work under Divisions 21 through 23 includes coordinating the electrical requirements of all mechanical equipment with the requirements of the work under Divisions 26 through 28, before ordering the equipment.

1. If motor horsepowers are changed under the work of Divisions 21 through 23 without a change in duty of the motor's driven device, coordination of additional electrical work (if any) and additional payment for that work (if any) shall be provided under the section of Divisions 21 through 23 initiating the change. Increases or decreases in motor horsepower from that specified shall not be made without written approval from the Architect/Engineer.

PART 3 - EXECUTION – NOT USED

END OF SECTION

This page is intentionally left blank.

SECTION 26 05 02 - BASIC MATERIAL AND METHODS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. This Section supplements Division 1, General Requirements.

1.2 DESCRIPTION OF WORK

A. Work included in this section consists of conduits, wires and other miscellaneous materials not specifically mentioned in other sections of Division 26, 27 and 28 but necessary or required for equipment or system operation or function, and the labor to install them.

1.3 SUBMITTALS

A. Materials list with manufacturer, style, series or model identified.

B. Manufacturer’s descriptive literature and/or sample if requested by the Architect/Engineer.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Refer to Section 26 05 03.

2.2 CONDUIT RACEWAYS

A. Refer to Section 26 05 33.

2.3 ELECTRICAL POWER CONDUCTORS AND CABLES

A. Refer to Section 26 05 19.

2.4 WIRING DEVICES

A. Refer to Section 26 27 26.

2.5 OUTLET BOXES, JUNCTION AND PULL BOXES

A. Outlet Boxes: Hot-dipped galvanized or sherardized of required size, 4” square minimum, for flush-mounted devices and lighting fixtures. Cast-type FD with gasketed covers for surface-mounted devices.

B. Junction and Pull Boxes: Use outlet boxes as junction boxes wherever possible. Larger junction and pull boxes shall be fabricated from code-gauge sheet steel, with screw-on covers; of types, shapes and sizes, to suit each respective location and installation; with welded seams and equipped with stainless-steel nuts, bolts, screws, and washers. Pull and junction boxes installed in finished spaces must be flush-mounted cabinets provided with trim, hinged door and flush latch and lock to match flush-mounted panelboard trim. Provide galvanized code-gauge steel where required for outdoor exposure.

C. All exterior boxes shall be in use gasketed, weatherproof type with cast metallic covers.

D. Refer to Section 26 05 33 for additional requirements.

2.6 WIRE CONNECTORS

A. For wires that are #8 AWG and smaller: Insulated pressure type with live spring, rated 105°C, 600-Volt, for building wiring and 1000-Volt in signs or fixtures.

B. For wires that are #6 AWG and larger: Compression type with 3M #33 or equal tape insulation.

2.7 CONDUIT HANGERS

A. Refer to Section 26 05 29 for additional requirements.

2.8 FUSES

A. Refer to Section 26 28 16.

2.9 ACCESS PANELS

A. Electrical Contractor to provide access panels for electrical equipment which are required for accessibility by code.

2.10 CONDUIT SLEEVES

A. Sleeves for Conduit Penetration: Hilti, Inc., model CP 6820-P; or 3M Corp. MCID or PCID. Refer to Division 7 “Firestopping” for additional requirements.

B. Exterior Wall Penetration Seals: Provide seals at all foundation of exterior wall locations. Link Seal or approved manufacturer.

1. New Construction – Cast in place shall be Century Line (HDPE) or Steel Wall Sleeve
2. Exiting Construction – Core Drilled

C. Seal Product:

	Seal Element	Intended Application
C	EPDM (Black)	Direct ground burial, occasional or periodic water contact.
L	EPDM (Blue)	Use with fragile pipe and tubing. Direct ground burial, occasional or periodic water contact.
O	Nitrile	Oil, fuel and solvent resistant.
T	Silicone	Extreme temperatures rated (-55˚C - +204˚C).
S-316	EPDM (Black)	Chemical processing & wastewater treatment. High level of water resistance, inorganic acids and alkalis, and most organic chemicals.
LS-316	EPDM (Blue)	Use with fragile pipe and tubing. Chemical processing & wastewater treatment. High level of water resistance, inorganic acids and alkalis, and most organic chemicals.
OS-316	Nitrile	Oil resistant rubber with stainless steel hardware.

2.11 INTERNAL CONDUIT SEALANT

A. Conduit sealant shall be used in all conduits penetrating the building envelope or moisture barrier to prevent rodents and moisture. Sealant shall be able to be removed without damaging the conductors.

1. Conduits 2” or greater – Polywater FST or approved equal.
2. Conduits <2” – Poly Water FST Mini or approved equal.

2.12 EQUIPMENT MOUNTING AND SUPPORT HARDWARE

A. Steel channels, bolts and washers, used for mounting or support of electrical equipment shall be galvanized typed. Where installed in corrosive atmosphere, stainless-steel type hardware shall be used.

B. Refer to Section 26 05 29 for additional requirements.

PART 3 - EXECUTION

3.1 GENERAL

A. Provide complete raceway systems for all conductors including control wiring and low-voltage wiring unless otherwise noted.

B. Electrical system layouts indicated on drawings are generally diagrammatic, but shall be followed as closely as actual construction and work of other trades will permit. Govern exact routing of raceways and locations of outlets by structure and equipment served. Take all dimensions from architectural drawings.

C. All home runs to panelboards are indicated as starting from the outlet nearest to the panel and continuing in the general direction of that panel. Continue such circuits to panel as though routes were completely indicated.

D. Avoid cutting and boring holes through structure or structural members wherever possible. Obtain prior approval of the Architect, and conform to all structural requirements when cutting or boring structure.

E. Furnish and install all necessary hardware, hangers, blocking, brackets, bracing, runners, etc., required for equipment specified under this Section.

F. Furnish and install all hardware and equipment that meets the classifications and requirements of the space of installation.

G. Furnish and install all raceways from elevator machine room to fire command center for elevator status.

3.2 RACEWAYS

A. Refer to Section 26 05 33.

3.3 OUTLETS

A. Exact location of outlets and equipment shall be governed by structural conditions and obstructions or other equipment items. When necessary, relocate outlets so that when fixtures or equipment are installed, they will be symmetrically located according to room layout and will not interfere with other work or equipment. Verify final location of all outlets, panels, equipment, etc., with the Architect/Engineer.

B. Provide zinc-coated or cadmium-plated sheet steel outlet boxes not less than 4” octagonal or square, unless otherwise noted. Equip fixture outlet boxes with 3/8” no-bolt fixture studs. Where fixtures are mounted on or in an accessible type ceiling, provide a junction box and extend flexible conduit to each fixture. Outlet boxes in finished ceilings or walls shall be fitted with appropriate covers, set to come flush with the finished surface. Where more than one switch or device is located on one point, use gang boxes and covers unless otherwise indicated. Sectional switch boxes or utility boxes will not be permitted. Provide tile box or a 4” square box with tile ring in masonry walls which will not be plastered or furred, or where “dry-wall” type materials are applied. Through the wall type boxes are not permitted. Install minimum 12” lateral separation for back to back boxes.

C. Surface-mounted devices are to be mounted in cast type boxes with gasketed covers: (Crouse-Hinds FS/FD or equal).

D. Dimensions unless shown on drawings are given below and are from finished floor to center line of outlets unless noted otherwise. Adjust heights of outlets in masonry walls to correspond with consistent brick or block course. Outlets in block walls shall be installed in core of block.

Wall Switches	4’ - 0” (to top of box)
Convenience outlets	1’ - 4” (to bottom of box) – gyp or 8” block 1’ – 6” (to bottom of box) – 6” block
Hallways	1’ - 6” (to bottom of box)
Above counter wall outlet	0’ - 8” (above counter to top of box, maximum 44” AFF, field verify height of backsplash)
Panelboards wall mounted	6’ - 6” (to top of back box)
Wall phone outlet	4’ - 0” (to top of box)
Tele/Data outlets	1’ - 6” (to bottom of outlet)
Fire alarm horns, speakers	ceiling or wall
Fire alarm pull stations	4’ - 0” (to top of device)
Fire alarm strobes	6’ - 8” or 6” below ceiling (whichever is lower)
Television outlets	Refer to A/V or architectural drawing.

Confirm final location and heights of all outlets, wall switches, and television outlets with architectural drawings and furniture plans prior to installation.

E. Outlets except over counters, benches, special equipment, baseboards, fin tube radiators, etc., or at wainscoting, shall be at a height to prevent interference to service equipment, or as noted on drawings.

F. Refer to Section 26 05 33 for additional requirements.

3.4 JUNCTION PULL BOXES

A. Construct junction or pull boxes not over 150 cubic inches in size shall be standard outlet boxes, and those over 150 cubic inches shall be constructed the same as “Cabinets,” with screw covers of same gauge metal. Removal covers must be accessible at all times.

B. Provide a standard access panel having a hinged metal door neatly fitted into a flush metal trim, where a junction box or equipment is located above non-accessible ceilings or behind finished walls. Coordinate location and type with the Architect.

END OF SECTION

This page is intentionally left blank.

SECTION 26 05 03 - MANUFACTURERS

PART 1 - GENERAL

1.1 DESCRIPTION

A. The following lists of manufacturers are for the specifications as identified.

B. All submittals and documentation shall be in accordance with the project General Requirements, Division 1.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with requirements, manufacturers offering products which may be incorporated in the work are listed herein. All manufacturers not listed shall be pre-approved prior to bid in order to be considered. Refer to Division 1 for pre-approval format.

TITLE	SPECIFICATION SECTION	MANUFACTURER
Electrical Power Conductors and Cables	26 05 19	Aetna Insulated Wire Cerro Wire CME Wire and Cable Encore Wire Southwire Co. Draka Lifeline (Rated Cable) Radix Duralife (Rated Fire Alarm)
Grounding and Bonding	26 05 26	ABB (Blackburn/Color-Keyed) nVent (Erico/Cadweld) Ideal Industries Hubbell (Burndy) VFC/Lyncole
Hangers and Supports		
- Slotted Metal Angle and U-channel Systems	26 05 29	ABB (Thomas and Betts Corp) Eaton (B-Line Systems) Atkore (Unistrut Diversified Products)
- Conduit Sealing Bushings	26 05 29	ABB (Thomas and Betts Corp.) Emerson (OZ/Gedney) Hubbell (RACO)

TITLE	SPECIFICATION SECTION	MANUFACTURER
Raceways		
- Conduit and Tubing	26 05 33	ABB (T&B - OCAL) Atkore (Allied Tube & Conduit) Carlon, Inc. JM Eagle Rob Roy Industries Wheatland
- Conduit Bodies	26 05 33	ABB (Thomas and Betts Corp.) Emerson (Appleton Electric) Eaton (Crouse-Hinds) Hubbell (Killark Electric)
Wireway and Enclosures	26 05 33	Eaton (Cooper B-Line) nVent (Hoffman) Hammond Mfg.
Surface Raceways	26 05 33	Hubbell Legrand (Wiremold)
Electrical Boxes and Fittings		
Raintight outlet boxes	26 05 33	ABB (T&B – Red Dot) Emerson (Appleton Electric) Eaton (Crouse – Hinds) Hubbell (RACO)
Bushings, knockout closures and locknuts	26 05 33	ABB (T&B – Steel City) Emerson (Appleton Electric) Eaton (Crouse – Hinds) Hubbell (RACO)
Identification	26 05 53	Ideal Industries, Inc. Panduit Corp. Seton Identification Product. Brady, Co.
Lighting Control System	26 09 43	Crestron ETC Acuity Controls Lutron Legrand (Wattstopper)
Low-Voltage Distribution Transformers	26 22 13	Eaton Siemens Schneider Electric (Square D)
Harmonic Mitigating Transformers	26 22 13	Eaton Hammond Power Solutions Powersmiths
Switchboards Panelboards	26 24 13 26 24 16	Eaton Siemens Schneider Electric (Square D)
Fused Coordination Panelboards	26 24 16	Bussmann Eaton Littelfuse Mersen

TITLE	SPECIFICATION SECTION	MANUFACTURER
Enclosed Bus Assembly	26 25 00	Eaton (Cooper Industries) ABB (GE) Siemens Schneider Electric (Square D)
Wiring Devices - Receptacles and Switches	26 27 26	Eaton (Cooper) Hubbell, Inc. Leviton Legrand (Pass & Seymour)
- Dimmers	26 27 26	Lutron Phillips
- Occupancy Sensors	26 27 26	Lutron Legrand (Wattstopper) Hubbell Sensorswitch
Enclosed Switches and Circuit Breakers - Circuit and Motor Disconnects	26 28 16	Eaton Siemens Schneider Electric (Square D)
Connections	26 28 16	ABB (Thomas and Betts Corp.) Emerson (Appleton Electric) Hubbel (Burndy Corp.) Ideal Industries, Inc.
Fuses (See Note)	26 28 16	Eaton (Bussman) Mersen (Ferraz Shawmut) Littelfuse
Diesel-Engine Driven Generator Sets	26 32 13	Caterpillar Tractor Co. Kohler Co. Cummins MTU
Automatic Transfer Switches	26 36 23	Caterpillar Kohler Co. Cummins MTU Russ Electric, Inc.
Lightning Protection	26 41 13	nVent (Erico Lightning Protection) Robbins Lightning, Inc. Thompson Lightning Protection VFC/Lyncole
Surge Protection Device	26 43 13	Refer to Section
Lighting Fixtures	26 51 00	Refer to Drawings

TITLE	SPECIFICATION SECTION	MANUFACTURER
Pole and Standards		
- Metal Poles	26 56 13	Millerbernd Mfg. Co. Union Metal Mfg. Co. Valmont Industries, Inc.
- Pole Hardware	26 56 13	Hercules, Inc. Hubbell (J.B. Chance) Joslyn Mfg. and Supply Co. Acuity (Lithonia) Eaton (McGraw-Edison) Maclean (Dixie Electrical) Preformed Line Products Co. Reliable Electric Co.
Addressable Fire Alarm System	28 46 00	Edwards System Technology JCI (Simplex Grinnell) Notifier Potter Honeywell Silent Night
NOTE: Contractor shall submit fuse coordination for the entire electrical distribution if alternate manufacturer is used.		

PART 3 - EXECUTION – NOT USED

END OF SECTION

SECTION 26 05 10 – TESTING AND CERTIFICATION

PART 1 - GENERAL

1.1 RELATED WORK SPECIFIED ELSEWHERE

A. Acceptance and startup testing requirements for electrical power distribution equipment and systems. Contractor shall retain and pay for the services of a recognized independent testing firm for purpose of performing inspections and tests as herein specified.

1. The testing firm shall provide all material, equipment, labor, and technical supervision to perform such tests and inspections.
2. It is the purpose of these tests to assure that all tested electrical equipment is operational and within industry and manufacturer's tolerances and is installed in accordance with design specifications.
3. The tests and inspections shall determine suitability for startup and energization.
4. The following equipment shall be tested and calibrated:
   Electrical Power Conductors and Cables – Section 26 05 19
   Grounding and Bonding – Section 26 05 26
   Low-Voltage Distribution Transformers – Section 26 22 13
   Distribution Switchboards – Section 26 24 13
   Panelboards – Section 26 24 16
   Diesel-Engine Driven Generator Set - Section 26 32 13
   Automatic Transfer Switch – Section 26 36 23

1.2 SUBMITTALS

A. Provide submittal per Contract General Conditions, Division 1, and Section 26 05 00.

B. Qualification of testing firm.

C. One electronic copy of blank forms for checklists, test reports, and other related forms for Engineer's review and approval.

D. Submit test schedule and detailed test agenda outlining procedures, for Architect/Engineer's review.

E. Submit one electronic copy of certified test reports to Engineer for approval.

F. All tests, and reports shall be sealed by a registered electrical professional engineer with a current Maryland stamp

1.3 GENERAL REQUIREMENTS

A. The Contractor shall perform routine insulation resistance, continuity, and rotation tests for all distribution and utilization equipment prior to and in addition to any acceptance testing.

B. The Contractor shall test all lighting, low-voltage relays and circuits to ensure proper operating conditions prior to acceptance testing.

C. The Contractor shall perform visual and mechanical inspections, verifying that the equipment nameplate information meets the intent of the drawings and specifications.

D. The Contractor shall be responsible for all final settings and adjustments on protective devices and tap changes, submitting settings to the Architect/Engineer for review.

E. The Contractor shall engage the services of a recognized corporate and financially independent testing firm for the purpose of performing inspections and tests as herein specified.

F. The firm shall provide all material, equipment, labor, and technical supervision to perform such tests and inspections.

G. It is the purpose of these tests to assure that all tested electrical equipment is operational and within industry and manufacturer's tolerances and is installed in accordance with design specifications.

H. The tests and inspections shall determine suitability for energization. Equipment shall not be energized until accepted by the testing firm.

1.4 QUALIFICATIONS OF TESTING FIRM

A. The testing firm shall be a recognized corporate and financially independent testing organization which can function as an unbiased testing authority, professionally independent of the manufacturers, suppliers, and installers of equipment or systems evaluated by the testing firm.

B. The testing firm shall be regularly engaged in the testing of electrical equipment devices, installations, and systems.

C. The testing firm shall meet OSHA criteria for accreditation of testing laboratories, Title 29, Part 1907, or be a Full Member company of the InterNational Electrical Testing Association (NETA).

D. The lead, on-site, technical person shall be currently certified by the InterNational Electrical Testing Association (NETA) or National Institute for Certification in Engineering Technologies (NICET) in electrical power distribution system testing.

E. The testing firm shall utilize engineers and technicians who are regularly employed by the firm for testing and engineering services.

F. The testing firm shall submit proof of the above qualifications.

G. The terms used herewith, such as test agency, test contractor, testing laboratory, or contractor test company, shall be construed to mean the testing firm.

1.5 APPLICABLE CODES, STANDARDS, AND REFERENCES

A. All inspections and tests shall be in accordance with the following codes and standards except as provided otherwise herein:

1. National Electrical Manufacturer's Association - NEMA
2. American Society for Testing and Materials - ASTM
3. Institute of Electrical and Electronic Engineers - IEEE

4. InterNational Electrical Testing Association - NETA Acceptance Testing Specifications - ATS-2021
5. American National Standards Institute - ANSI C2: National Electrical Safety Code
6. State and City of Annapolis, Maryland Codes and Ordinances
7. Insulated Cable Engineers Association - ICEA
8. Association of Edison Illuminating Companies - AEIC
9. Occupational Safety and Health Administration - OSHA
10. National Fire Protection Association - NFPA

    a. ANSI/NFPA 70: National Electrical Code
    b. ANSI/NFPA 70B: Electrical Equipment Maintenance
    c. NFPA 70E: Electrical Safety Requirements for Employee Workplaces
    d. ANSI/NFPA 780: Lightning Protection Code
    e. ANSI/NFPA 101: Life Safety Code

11. National Institute for Certification in Engineering Technologies (NICET).

B. All inspections and tests shall utilize the following references:

1. Project design specifications.
2. Project design drawings.
3. Short-circuit and coordination study.
4. Manufacturer’s instruction manuals applicable to each particular apparatus.
5. Project list of equipment to be inspected and tested as stated above.

PART 2 - INSPECTION AND TEST PROCEDURES

2.1 PROCEDURE

A. Testing firm to provide and comply with the following:

1. Acceptance test procedures for each individual equipment listed in Part 1 of this section for Engineer review and approval prior to any test and after thorough evaluation of the system. Testing shall conform to the latest version of InterNational Electrical Testing Association (NETA) specifications and standards for electrical power distribution equipment and systems and manufacturer’s instructions.
2. Refer to each individual specification section for testing requirements and comply.
3. Upon completion of the work, and as a condition for acceptance, test components and systems in the presence of the Owner’s representative to demonstrate compliance with the specifications. Provide tests as specified and as required by the code or enforcing authorities. Adjust, repair and/or replace defective material and equipment.
4. Provide supervisory personnel experienced with the particular systems involved, and, where specified, arrange for the presence of factory representatives to direct indicated testing. Check field connections prior to testing.
5. All results shall be submitted to the Design Engineer for approval.

2.2 THERMOGRAPHIC INSPECTION:

A. After project loads are in full operation, perform a thermographic inspection of the electrical equipment and connections at a time acceptable to the Owner and in the presence of his authorized representative.

B. The purpose of the inspection is to locate high resistive points by comparing temperature levels to reference temperatures.

C. Utilize an infrared camera with a range of -20°C to 900°C and an accuracy of 0.1°C. Equip camera with a minimum of three lenses: 7°C telephoto, 20°C wide angle and 40°C extra wide angle. Utilize camera to detect infrared wave lengths and convert them into video signals projected onto a monitor screen in the form of a line thermal image to be photographed for inclusion in the report. Heat loss survey to be in both gray step mode and color. Submit camera characteristics with report.

D. Inspect the entire electrical system, including:

1. Dry type general purpose transformers.
2. Liquid cooled transformers.
3. Medium voltage switchgear.
4. Switchboard, panelboards, motor control centers, busways.
5. Circuit breakers, disconnect switches.
6. Standby generator, automatic transfer switches.

E. Include in test report, thermographs and photographs of defective equipment and connections. Outline probable cause, severity of defect and corrective measure recommendations.

F. Correct deficiencies as agreed upon at no cost to Owner. Rephotograph corrected areas and resubmit data indicating satisfactory conditions.

2.3 SYSTEM FUNCTION TESTS

A. General:

1. Perform system function tests upon completion of equipment component tests as define in this specification. It is the purpose of system function tests to prove the proper interaction of all sensing, processing, and action devices.
2. Implementation:

   a. Develop test parameters for the purpose of evaluating performance of all integral components and their functioning as a complete unit within design requirements.
   b. Test all interlock devices, and trip settings on breakers.
   c. Record the operation of alarms and indicating devices.

2.4 DEFICIENCIES

A. All deficiencies reported by testing firm to be corrected by Contractor and Acceptance Test to be re-done accordingly.

2.5 ADJUSTMENTS: AFTER PROJECT LOADS ARE IN FULL OPERATION, AND AT A TIME ACCEPTABLE TO THE OWNER:

A. Take voltage readings at each transformer. Where voltage on secondary of building transformers is above or below required rating in excess of 2-1/2 percent at full load, make appropriate tap changes.

B. Take current readings on each phase at each panel. Adjust branch circuiting between phases where required to balance phase currents within 10 percent. Reflect revisions in revised typed panel schedules. Circuit revisions shall not compromise multi-wire circuits sharing a common neutral.

C. Tabulate adjustment data by transformer and panel and submit with test data.

PART 3 - EXECUTION (NOT USED)

END OF SECTION

This page is intentionally left blank.

SECTION 26 05 19 - ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

B. Requirement of the following Division 26 Sections apply to this section:

1. Electrical Requirements

1.2 SUMMARY

A. This Section includes wires, cables, and connectors for power, lighting, signal, control and related systems rated 600-Volts and less.

B. Related Sections: The following Sections contain requirements that relate to this section:

1. Division 31 Section “Earthwork” for trenching and backfilling.
2. Division 26 Section “Electrical Boxes and Fittings” for connectors for terminating cables in boxes and other electrical enclosures.
3. Division 26 Section “Raceways and Boxes” for MC cable, raceway and boxes.

1.3 SUBMITTALS

A. Product Data for electrical wires, cables and connectors.

B. Submit pulling tension calculations for all underground feeders.

1.4 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with provisions of the following code:

B. NFPA 70 “National Electrical Code.”

1. Conform to applicable codes and regulations regarding toxicity of combustion products of insulating materials.

C. UL Compliance: Provide components, which are listed and labeled by UL under the following standards.

1.	UL Standard 44	Rubber Insulated Wires and Cables
2.	UL Standard 83	Thermoplastic-Insulated Wires and Cables
3.	UL Standard 486A	Wire Connectors and Soldering Lugs for Use with Copper Conductors

4. UL Standard 486B Wire Connectors and Soldering Lugs for Use with Aluminum Conductors
5. UL Standard 486C Splicing Wire Connectors
6. UL Standard 854 Service Entrance Cable
7. UL Standard 2196 Testing for Fire Resistive Cables
8. UL Standard 1424 Cables for Power-Limited Fire-Alarm Circuits

D. NEMA/ICEA Compliance: Provide components which comply with the following standards:

1. WC-5: Thermoplastic-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.
2. WC-7: Cross Linked Thermosetting Polyethylene-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.

E. IEEE Compliance: Provide components, which comply with the following standard.

1. Standard 82: Test procedures for Impulse Voltage Tests on Insulated Conductors.

PART 2 - PRODUCTS

2.1 WIRES AND CABLES (600-VOLT COPPER CONDUCTORS)

A. General: Provide suitable wire and cable for the temperature, conditions and location where installed. All wires and cables shall be new and delivered to the site in unbroken packages and reels.

B. All wires and cables shall be of the same manufacturer throughout the entire project.

C. Conductors: Provide solid conductors for power and lighting circuits #10 AWG and smaller. Provide stranded conductors for #8 AWG and larger.

D. Conductor Material: All wires and cables shall be copper, single conductor rated at 600-Volts, which conform to or exceed ICEA specifications and the following:

1. In sizes 1/0 AWG to 4/0: Cross-linked polyethylene insulation type XHHW-2 (90°C) or THWN-2.
2. In sizes 250 KCMIL and larger: Type XHHW-2 (90°C) or THWN.
3. In sizes 1 AWG and smaller: All conductors shall have heat/moisture resistant thermoplastic insulation type THWN-2 (90°C) except as follows:

    a. Where conduit temperature will exceed 100°F, use type THHN (90°C).
    b. In 120-Volt incandescent fixtures, type SF-2 or SFF-2 (150 - 200°C).
    c. In wireway of fluorescent lighting fixtures type THHN (90°C).

E. Rated Conductor Material: Where required by these specifications and code, provide 2-hour rated cable conforming to the following requirements:

1. Cabling must meet current UL requirements for fire alarm resistance.
2. Cabling must meet current NEC 517, 700 and 760 requirements.

F. Grounding conductors: Shall be of the same type as its associated phase conductors.

G. All conductors shall be label with wire size, insulation rating, etc. using an engraved process, computer scan on labels are not permitted.

H. Color Coding for phase identification in accordance with Table 1 in Part 3 herein.

I. Connectors for Conductors:

1. Provide UL-listed factory-fabricated, solderless metal connectors of sizes, ampacity ratings, materials, types and classes for applications and for services indicated. Use connectors with temperature ratings equal to or greater than those of the wires upon which used.
2. For wires that are #8 AWG and smaller: Insulated pressure type with live spring, rated 105°C, 600-Volt, for building wiring and 1000-Volt in signs or fixtures.
3. For wires that are #6 AWG and larger: Compression type with 3M #33 or equal tape insulation.

J. Splices and Taps:

1. No. 10 AWG and smaller - Connectors for solid conductors shall be solderless, screw-on, spring pressure cable type, 600-Volt, 105°C with integral insulation and UL approved for aluminum and copper conductors. Connectors for stranded conductors shall be crimp-on type with integral insulating cover.
2. No. 8 AWG and larger - Hydraulically applied crimping sleeve or tap connector sized for the conductors. Insulate the hydraulically applied connector with 90-degree, 600-Volt insulating cover provided by the connector manufacturer. Insulator materials and installation shall be approved for the specific application, location, voltage, and temperature and shall not have an insulation value less than the conductors being joined.

2.2 TWO-HOUR RATED CABLE ASSEMBLY

A. Two Hour Rated Cable Assemblies: Complete cable system shall have a two-hour fire rating as Listed and Classified by Underwriters Laboratories, Inc. or ETL.

1. Two-hour rated cable assemblies or two-hour rated cable systems that are approved by the authority having jurisdiction can be used in lieu of two (2) inch concrete encasement or routing in two (2) hour fire rated enclosure for the following applications:

a. Trunk cabling for fire alarm detection and annunciation.
b. Feeders for fire pumps.
c. Emergency feeders.
d. Life Safety feeders.
e. Feeders for Smoke control, stair pressurization, and hoist way pressurization.
f. Cabling for Area of Rescue Assistance System.

2. Conduit sizes shall be adjusted to accommodate the larger diameter conductors per the national electrical code.

PART 3 - EXECUTION

3.1 WIRING METHOD

A. Use the following wiring methods as indicated:

1. Install all wire in raceway. Power and control wiring shall be installed in separate raceways.

3.2 INSTALLATION OF WIRES AND CABLES

A. General: Install electrical cables, wires, and connectors in compliance with NEC.

B. Coordinate cable and wire installation with other Work.

C. Do not install more conductors in a raceway than indicated on the drawings. A maximum of three ungrounded conductors are to be installed in any one conduit on a 3-phase, 4-wire system, unless specifically noted otherwise on the drawings. When more than three ungrounded conductors are installed in a raceway, the conductor size shall be increase per code for derating. No two ungrounded conductors of the same phase are to be installed in the same conduit, unless specifically noted otherwise on the drawings.

1. Where multi-wire circuits are permitted by these specifications, all grounded and ungrounded conductors shall be grouped by wire markers, cable ties or similar means with the panelboard or wireway at least one location.

D. Provide dedicated neutral conductor for all single phase circuits. Shared neutral conductor is not acceptable on single phase circuits.

E. Minimum wire size shall be a No.12 AWG except for control or signal circuits, which may be No. 14 AWG.

F. Unless otherwise indicated on drawings, all wiring for branch circuits shall be a minimum No. 12 AWG in ¾” conduit, protected by 20 amperes circuit breakers. If distance from panel to first outlet is 75 feet or greater for 120-Volt circuits, and 125 feet or greater for 277-Volt circuits, No. 10 AWG shall be installed throughout the circuit, unless noted otherwise on the drawings.

G. Size of current carrying conductors, unless noted otherwise on drawings, shall be determined from Table 310.15(B)(16) of the latest National Electric Code for the load served.

H. Pull conductors simultaneously where more than one is being installed in same raceway. Use UL listed pulling compound or lubricant, where necessary.

I. Use pulling means including fish tape, cable, rope, and basket weave wire/cable grips which will not damage cables or raceways. Do not use rope hitches for pulling attachment to wire or cable.

J. Size of conduits, unless specifically shown, shall be determined from Appendix C of the latest National Electrical Code.

K. Keep conductor splices to a minimum. All splices shall be made within junction boxes, wiring troughs and other enclosures as permitted by the National Electrical Code.

1. Splices shall not be permitted within 25 feet of any panel or electrical room.
2. Do not splice conductors in panelboards, safety switches, switchboards, motor control centers or motor control enclosures.
3. Splices in conductors installed below grade will not be permitted, unless approved in writing by the Architect and Engineer.

L. Install splice and tap connectors, which possess equivalent or better mechanical strength and insulation rather than conductors being spliced.

M. Use splice and tap connectors which are compatible with conductor material.

N. Provide adequate length of conductors within electrical enclosures and train the conductors to terminal points with no excess. Bundle multiple conductors, with conductors larger than No. 10 AWG cabled in individual circuits. Make terminations so there is no more than 3/16" of bare conductor at the terminal.

O. Tighten electrical connectors and terminals, including screws and bolts, in accordance with manufacturers' published torque tightening values. Where manufacturers' torque requirements are not indicated, tighten connectors and terminals to comply with tightening torque values specified in UL 486A and UL 486B. After tightening the connection/terminal, mark the bolt surface and that of the product or workpiece. Then loosen the bolt. Re-tighten it until the markings re-align. The torque needed to return the bolt to its original position is the torque value of the bolt.

3.3 FIELD QUALITY CONTROL

A. Prior to energizing, check installed wires and cables with megohm meter to determine insulation resistance levels to assure requirements are fulfilled.

B. Prior to energizing, test wires and cables for electrical continuity and for short circuits.

C. Subsequent to wire and cable hook-ups, energize circuits and demonstrate proper functioning. Correct malfunctioning units, and retest to demonstrate compliance.

D. Prior to completion of project, an infrared scan of switchgear and panelboard feeder equipment connection shall be performed when all loads are energized.

E. TABLE I: Color Coding for Phase Identification:

1. Color code secondary service, feeder, and branch circuit conductors with factory applied color as follows:

208V/120-Volts	Phase	480V/277-Volts
Black	A	Brown
Red	B	Orange
Blue	C	Yellow
White	Neutral	Gray
Green	Ground	Green

3.4 FEEDER TESTING

A. Products

1. Material: Contractor shall provide all necessary testing equipment and devices required to perform the test described in this section.

B. Execution

1. Visual and Mechanical Inspection

a. Inspect cables for physical damage and proper connection in accordance with one-line diagrams.
b. Test cable mechanical connections to manufacturer's recommended values using a calibrated torque wrench.
c. Check cable color coding with specification section 26 05 53 and National Electrical Code standards.

2. Electrical Tests

a. Perform insulation-resistance test on each conductor with respect to ground and adjacent conductors. Applied potential shall be 1000-Volts D.C. for 1 minute.
b. Perform continuity test to insure proper cable connection.

3. Test Values

a. Evaluate results by comparison with cables of same length and type. Investigate any insulation-resistance values less than 50 megohms.
b. Submit results to Engineer for approval in accordance with Section 26 05 10.

END OF SECTION

SECTION 26 05 26 - GROUNDING AND BONDING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work of this section.

B. Division 26 Basic Materials and Methods sections apply to work of this section.

C. Requirements of this section apply to electrical grounding and bonding work specified elsewhere in these specifications.

1.2 SUMMARY

A. Extent of electrical grounding and bonding work is indicated by drawings and schedules and as specified herein. Grounding and bonding work is defined to encompass systems, circuits, and equipment.

B. Type of electrical grounding and bonding work specified in this section includes the following:

1. Solidly grounded.

C. Applications of electrical grounding and bonding work in this section includes the following:

1. Underground metal piping.
2. Underground metal water piping.
3. Underground metal structures.
4. Building frames - structural steel.
5. Electrical power systems.
6. Grounding electrodes.
7. Separately derived systems.
8. Raceways.
9. Service equipment.
10. Enclosures.
11. Equipment.
12. Lighting Standards.
13. Landscape Lighting.
14. Signs.

D. Refer to other Division 26 sections for wires/cables, electrical raceways, boxes and fittings, and wiring devices which are required in conjunction with electrical grounding and bonding work; not work of this section.

1.3 SUBMITTALS

A. Product Data: Submit manufacturer's data on grounding and bonding products and associated accessories.

B. Wiring Diagrams: Submit wiring diagrams for electrical grounding and bonding work which indicates layout of ground rods, location of system grounding electrode connections, routing of grounding electrode conductors, also include diagrams for circuits and equipment grounding connections.

C. Submit ground riser diagram for entire project. Show bus bars with transformer ground electrode conductors, etc.

1.4 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of grounding and bonding products, of types, and ratings required, and ancillary grounding materials, including stranded cable, copper braid and bus, grounding electrodes and plate electrodes, and bonding jumpers whose products have been in satisfactory use in similar service for not less than 5 years.

B. Installer's Qualifications: Firms with at least 5 years of successful installation experience on projects with electrical grounding work similar to that required for project.

C. Codes and Standards:

1. Electrical Code Compliance: Comply with applicable local electrical code requirements of the authority having jurisdiction, and NEC as applicable to electrical grounding and bonding, pertaining to systems, circuits and equipment.
2. ANSI Compliance: C119.4 Electrical Connectors,
3. UL Compliance: Comply with applicable requirements of UL Standards No.'s 467, Electrical Grounding and Bonding Equipment", and 869 "Electrical Service Equipment", pertaining to grounding and bonding of systems, circuits and equipment. In addition, comply with UL Standard 486A-486B, "Wire Connectors and soldering Lugs for Use with Copper Conductors." UL Standard 486C "Splicing Wire Connectors" UL1059 "Terminal Blocks. Provide grounding and bonding products which are UL-listed and labeled for their intended usage.
4. IEEE Compliance: Comply with applicable requirements and recommended installation practices of IEEE Standards 80, 81, 141 and 142 pertaining to grounding and bonding of systems, circuits and equipment.
5. NFPA Compliance: NFPA 70 National Electrical Code, NFPA 780" Standard for the Installation of Lightning Protection Systems"

PART 2 - PRODUCTS

2.1 GENERAL

A. Materials and Components:

1. Provide electrical grounding and bonding system; with assembly of materials, including, but not limited to, cables/wires, connectors, solderless lug terminals, grounding electrodes and plate electrodes, bonding jumper braid, surge arresters, and additional accessories needed for a complete installation. Where more than one type component product meets indicated requirements, selection is installer's option. Where materials or components are not indicated provide products which comply with NEC, UL, and IEEE requirements and with established industry standards for those applications indicated.

2.2 CONDUCTORS

A. Insulated Conductors: Copper wire or cable insulated for 600V unless otherwise required by applicable Code or authorities having jurisdiction.

B. Bare Copper Conductors:

1. Solid Conductors: ASTM B3.
2. Stranded Conductors: ASTM B8.
3. Tinned Conductors: ASTM B33.
4. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductors, 1/4 inch (6 mm) in diameter.
5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductors.
6. Bonding Jumper: Copper tape, braided conductors, terminated with copper ferrules; 1-5/8 inches (41 mm) wide and 1/16 inch (1.6 mm) thick.
7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors, terminated with copper ferrules; 1-5/8 inches (41 mm) wide and 1/16 inch (1.6 mm) thick.

C. Bare Grounding Conductor and Conductor Protector for Wood Poles:

1. No. 4 AWG minimum, soft-drawn copper.
2. Conductor Protector: Half-round PVC or wood molding. If wood, use pressure-treated fir or cypress or cedar.

D. Grounding Bus: Rectangular bars of annealed copper 1/4 by 3 by 12 inches (6 by 76 by 300 mm) in cross section, unless otherwise indicated; with insulators.

2.3 CONNECTORS

A. Listed and labeled by a nationally recognized testing laboratory acceptable to authorities having jurisdiction for applications in which used, and for specific types, sizes, and combinations of conductors and other items connected.

B. Bolted Mechanical Connectors for Conductors and Pipes: Copper or copper alloy, bolted pressure-type, with at least two bolts. Of type recommended by ABB (Blackburn/Color-Keyed) Installation Products, (Burndy) Hubbell Inc or equal.

1. Pipe Connectors: Clamp type, sized for pipe.

C. Irreversible Compression Connectors: Use for connections to structural steel and for underground connections except those at test well. Install connection to ground rods. Comply with manufacturer's written recommendations and training. Must be factory filled with an oxide inhibitor and installed with manufacturers recommend dies. The die index must match the listed index for the connector. Use of a 14 Ton or larger hydraulic compression tool to provide correct circumferential pressure for compression connectors and index die numbers are properly indented. Use tools and dies recommended by manufacturer of connectors. Provide embossing die code method to make visible indication that the connector has been adequately compressed on the ground conductor, ground rod or ground plate. Irreversible compression connectors may be used below grade, above grade and concrete incased applications. Of types recommended by ABB (Blackburn) Installation Products, Burndy (Hubbell Inc). or approved equal.

D. Welded Connectors: Exothermic-welding kits of types recommended by ABB (Furseweld) Installation Products, Burndy (Thermoweld) Hubbell Inc. Erico – nVent (Cadweld) (or approved equal) manufacturer for materials being joined and installation conditions. Exothermically welded connections are required on all grounding electrode conductors other than water pipes, all connections to building steel (connections to structural member), all grounding conductors run under the earth, connection to ground rods and in any case where grounding conductors are subject to a hostile environment.

1. The exothermic welding system furnished under these specifications shall meet the applicable requirements of IEEE80, Chapter 9, Section of conductors and joints.
2. Molds shall be made from graphite or other material that is so designed to provide an average life of not less than 50 exothermic welds under normal conditions. Molds shall bear permanent marking, indicating the name of the manufacturer, the mold model, the type and size of welding mixture compatible with the welding process, and the size of the conductor. Instructions detailing general safety information, and welding procedures shall be provided with each mold.
3. Starting material, if used, shall consist of aluminum and copper/copper oxide and iron oxides. It shall not contain phosphorous or any caustic, toxic or explosive substance. Weld metal used for grounding connections shall contain copper oxide, aluminum. Where welding is done in enclosed structures, the Erico Exolon smokeless system shall be used.

E. Exothermic connections are to be performed by manufacturer's trained personnel with a qualification and/or training certificate on file with the contractor.

2.4 GROUNDING ELECTRODES

A. Ground Rods: Copper-bonded steel; 3/4 inch by 10 feet (19 mm by 3 m) in diameter.

B. Chemical-Enhanced Grounding Electrodes: Copper tube, straight or L-shaped, charged with nonhazardous electrolytic chemical salts.

1. Termination: Factory-attached No. 4/0 AWG bare conductor at least 48 inches (1200 mm) long.
2. Backfill Material: Electrode manufacturer's recommended material.
3. Electrolytic Chemical Ground Rods of types recommended by Lyncole Grounding or approved equal.

PART 3 - EXECUTION

3.1 APPLICATIONS

A. Conductors: Install solid conductor for No.10 AWG and smaller, and stranded conductors for No.8 AWG and larger, unless otherwise indicated.

B. Underground Grounding Conductors: Install bare tinned copper conductor, No.3/0 AWG minimum.

1. Bury at least 24 inches (600 mm) below grade. In areas subject to long term and deeper freezing a lower depth may be in order.
2. Duct-Bank Grounding Conductor: Bury 12 inches (300 mm) above duct bank when indicated as part of duct-bank installation.
3. Copper Ground Loop: Bury a minimum of 30” below grade.

C. Isolated Grounding Conductors: Green-colored insulation with continuous yellow stripe. On feeders with isolated ground, identify grounding conductor where visible to normal inspection, with alternating bands of green and yellow tape, with at least three bands of green and two bands of yellow.

D. Grounding Bus: Install in electrical and telephone equipment rooms, in rooms housing service equipment, and elsewhere as indicated.

1. Install bus on insulated spacers 1 inch (25 mm), minimum, from wall 6 inches (150 mm) above finished floor, unless otherwise indicated.
2. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, down to specified height above floor, and connect to horizontal bus.

E. Conductor Terminations and Connections:

1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
2. Underground Connections: Welded connectors, except at test wells and as otherwise indicated.
3. Connections to Ground Rods at Test Wells: Bolted connectors.
4. Connections to Structural Steel: Welded connectors.

3.2 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS

A. Comply with IEEE C2 grounding requirements

B. Grounding Manholes and Handholes: Install a driven ground rod through manhole or handhole floor, close to wall, and set rod depth so 4 inches (100 mm) will extend above finished floor. If necessary, install ground rod before manhole is placed and provide No. 1/0 AWG bare, tinned-copper conductor from ground rod into manhole through a waterproof sleeve in manhole wall. Protect ground rods passing through concrete floor with a double wrapping of pressure-sensitive insulating tape or heat-shrunk insulating sleeve from 2 inches (50 mm) above to 6 inches (150 mm) below concrete. Seal floor opening with waterproof, nonshrink grout.

C. Grounding Connections to Manhole Components: Bond exposed-metal parts such as inserts, cable racks, pulling irons, ladders, and cable shields within each manhole or handhole, to ground rod or grounding conductor. Make connections with No. 4 AWG minimum, stranded, hard-drawn copper bonding conductor. Train conductors level or plumb around corners and fasten to manhole walls with 8”, minimum bend radius and no angles less than 90m degrees. Connect to cable armor and cable shields as recommended by manufacturer of splicing and termination kits.

D. Pad-Mounted Transformers and Switches: Install two ground rods and ground ring around the pad. Ground pad-mounted equipment and noncurrent-carrying metal items associated with substations by connecting them to underground cable and grounding electrodes. Install tinned-copper conductor not less than No.3/0 AWG for ground ring and for taps to equipment grounding terminals. Bury ground ring not less than 6 inches (150 mm) from the foundation.

3.3 EQUIPMENT GROUNDING

A. Install insulated equipment grounding conductors with all feeders and branch circuits. The conduit shall not be acceptable as an equipment ground.

B. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:

1. Feeders and branch circuits.
2. Lighting circuits.
3. Receptacle circuits.
4. Single-phase motor and appliance branch circuits.
5. Three-phase motor and appliance branch circuits.
6. Flexible raceway runs.
7. Armored and metal-clad cable runs.
8. Busway Supply Circuits: Install insulated equipment grounding conductor from grounding bus in the switchgear, switchboard, or distribution panel to equipment grounding bar terminal on busway.
9. Computer and Rack-Mounted Electronic Equipment Circuits: Install insulated equipment grounding conductor in branch-circuit runs from equipment-area power panels and power-distribution units.

C. Protection:

1. All grounding electrode conductors smaller than #6 AWG shall be routed in conduit – EMT or Rigid/IMC if exposed to damage or weather.
2. All grounding electrode conductors #6 AWG and larger shall be routed in conduit – EMT or Rigid/IMC if exposed to weather.

D. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.

E. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install a separate insulated equipment grounding conductor to each electric water heater and heat-tracing cable. Bond conductor to heater units, piping, connected equipment, and components.

F. Isolated Grounding Receptacle Circuits: Install an insulated equipment grounding conductor connected to the receptacle grounding terminal in addition to the equipment grounding conductor. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service, unless otherwise indicated.

G. Isolated Equipment Enclosure Circuits: For designated equipment supplied by a branch circuit or feeder, isolate equipment enclosure from supply circuit raceway with a nonmetallic raceway fitting listed for the purpose. Install fitting where raceway enters enclosure, and install a separate insulated equipment grounding conductor. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service, unless otherwise indicated.

H. Metal Poles Supporting Outdoor Lighting Fixtures: Install grounding electrode and a separate insulated equipment grounding conductor in addition to grounding conductor installed with branch-circuit conductors.

3.4 EXAMINATION

A. Examine areas and conditions under which electrical grounding and bonding connections are to be made and notify Engineer in writing of conditions detrimental to proper completion of work. Do not proceed with work until unsatisfactory conditions have been corrected.

3.5 INSTALLATION OF ELECTRICAL GROUNDING AND BONDING SYSTEMS

A. General: Install electrical grounding and bonding systems in accordance with manufacturer's instructions and applicable portions of NEC, NECA's "Standard of Installation", and in accordance with recognized industry practices to ensure that products comply with requirements.

B. Coordinate with other electrical work as necessary to interface installation of electrical grounding and bonding system work with other work.

C. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

D. Common Ground Bonding with Lightning Protection System: Comply with NFPA 780 and UL 96A when interconnecting with lightning protection system. Bond electrical power system ground directly to lightning protection system grounding conductor at closest point to electrical service grounding electrode. Use bonding conductor sized same as system grounding electrode conductor, and install in conduit.

E. Ground Rods: Drive rods until tops are 2 inches (50 mm) below finished floor or final grade, unless otherwise indicated.

1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating, if any.
2. For grounding electrode system, install at least three rods, spaced at least one-rod length from an adjacent grounding means (such as Ufer, building steel or cold water pipe).AND/OR two-rod lengths from an adjacent rod (i.e. 16' apart for 8' rods & 20' apart for 10' rods), and connect to the service grounding electrode conductor.

F. Test Wells: Provide test wells as required by the NEC.

1. Test Wells: Install at least one test well for each service, unless otherwise indicated. Install at the ground rod electrically closest to service entrance. Set top of test well flush with finished grade or floor.
2. Manhole Test Wells: Ground rod driven through drilled hole in bottom of manholes. Manholes are specified in Division 26 Section "Underground Services and Manholes," and shall be at least 12 inches (300 mm) deep, with cover.

G. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance, except where routed through short lengths of conduit.

1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install so vibration is not transmitted to rigidly mounted equipment
3. Use exothermic-welded connectors or irreversible compression connectors for outdoor locations, but if a disconnect-type connection is required, use a bolted clamp.

H. Grounding and Bonding for Piping:

1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, each unit substation, or each main electrical room grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes, using a bolted clamp connector or by bolting a lug-type connector to a pipe flange, using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.

I. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install tinned bonding jumper to bond across flexible duct connections to achieve continuity.

J. Grounding for Steel Building Structure: Install a driven ground rod at base of each corner column and at intermediate exterior columns at distances not more than 60 feet (18 m) apart.

K. Ground Ring: Install a grounding conductor, electrically connected to each building structure ground rod and to each steel column, extending around the perimeter of building.

1. Install tinned-copper conductor not less than No.4/0 AWG for ground ring and for taps to building steel.
2. Bury ground ring not less than 24 inches (600 mm) from building foundation.

L. Ufer Ground (Concrete-Encased Grounding Electrode): Fabricate according to NFPA 70, using a minimum of 20 feet (6m) of bare copper conductor not smaller than No. 4/0 AWG.

1. If concrete foundation is less than 20 feet (6 m) long, coil excess conductor within base of foundation.
2. Bond grounding conductor to reinforcing steel in at least four locations and to anchor bolts. Extend grounding conductor below grade and connect to building grounding grid or to grounding electrode external to concrete.

M. Tighten grounding and bonding connectors and terminals, including screws and bolts, in accordance with manufacturer's published torque tightening values for connectors and bolts. Where manufacturer's torquing requirements are not indicated, tighten connections to comply with tightening torque values specified in UL 486A to assure permanent and effective grounding.

N. Apply corrosion-resistant finish to field-connections, buried metallic grounding and bonding products, and places where factory applied protective coatings have been destroyed, which are subjected to corrosive action.

O. Install all connectors on clean metal contact surfaces, to ensure electrical conductivity and circuit integrity.

3.6 FIELD QUALITY CONTROL

A. Upon completion of installation of electrical grounding and bonding systems, test ground resistance with ground resistance tester. Where tests show resistance to ground is over 5 ohms, take appropriate action to reduce resistance to 5 ohms, or less, by driving additional ground rods; then retest to demonstrate compliance.

END OF SECTION

This page is intentionally left blank.

SECTION 26 05 29 - HANGERS AND SUPPORTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

B. Requirements of the following Division 26 Sections apply to this section:

1. “Electrical Requirements.”

1.2 SUMMARY

A. This Section includes secure support from the building structure for electrical items by means of hangers, supports, anchors, sleeves, inserts, seals, and associated fastenings.

B. Related Sections: The following Sections contain requirements that related to this Section:

1. Division 3 Section “Mild Steel Concrete Reinforcement” for inserts, anchors, and sleeves to be installed in concrete for use with supporting devices.
2. Division 5 Section “Metal Fabrications” for requirements for miscellaneous metal items involved in supports and fastenings.
3. Division 7 Section “Firestopping” for requirements for firestopping at sleeves through walls and floors that are fire barriers.
4. Refer to Division 26 Sections for additional specific support requirements that may be applicable to specific items.

1.3 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.

B. Product data for each type of product specified.

1. Hanger and support schedule showing manufacturer’s figure number, size, spacing, features, and application for each required type of hanger, support, sleeve, seal, and fastener to be used.

C. Shop drawings indicating details of fabricated products and materials.

D. Engineered Design consisting of details and engineering analysis for supports for the following items:

1. Cable Tray.
2. Conduit (racked)
3. Ceiling-mounted boxes, transformers.
4. Conduit - Ceiling mounted, concrete encased.

1.4 QUALITY ASSURANCE

A. Electrical Component Standard: Components and installation shall comply with NFPA 70 “National Electrical Code.”

B. Electrical components shall be listed and labeled by UL, ETL, CSA, or other approved, nationally recognized testing and listing agency that provides third-party certification follow-up services.

C. Installation shall comply with local authorities seismic requirements.

PART 2 - PRODUCTS

2.1 COATINGS

A. Coating: Supports, support hardware, and fasteners shall be protected with zinc coating or with treatment of equivalent corrosion resistance using approved alternative treatment, finish, or inherent material characteristic. Products for use outdoors shall be hot-dip galvanized and where installed in corrosive atmosphere, stainless-steel type channel and hardware shall be used.

2.2 MANUFACTURED SUPPORTING DEVICES

A. Raceway Supports: Clevis hangers, riser clamps, conduit straps, threaded C-clamps with retainers, ceiling trapeze hangers, wall brackets, and spring steel clamps.

B. Hanger Rods: Threaded high tensile strength galvanized carbon steel with free running threads. Aircraft cable and other non-rigid supports shall not be permitted for use as supporting material for conduit.

C. Fasteners: Types, materials, and construction features as follows:

1. Expansion Anchors: Carbon steel wedge or sleeve type.
2. Toggle Bolts: All steel springhead type.

D. Conduit Sealing Bushings: Factory-fabricated watertight conduit sealing bushing assemblies suitable for sealing around conduit, or tubing passing through concrete floors and walls. Construct seals with steel sleeve, malleable iron body, neoprene sealing grommets or rings, metal pressure rings, pressure clamps, and cap screws.

E. Cable Supports for Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug for nonarmored electrical cables in riser conduits. Provide plugs with number and size of conductor gripping holes as required to suit individual risers. Construct body of malleable-iron casting with hot-dip galvanized finish.

F. U-Channel Systems: 16-gauge steel channels, with 9/16-inch-diameter holes, at a minimum of 8 inches on center, in top surface. Provide fittings and accessories that mate and match with U-channel and are of the same manufacture.

2.3 FABRICATED SUPPORTING DEVICES

A. General: Shop- or field-fabricated supports or manufactured supports assembled from U-channel components.

B. Steel Brackets: Fabricated of angles, channels, and other standard structural shapes. Connect with welds and machine bolts to form rigid supports.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install supporting devices to fasten electrical components securely and permanently in accordance with NEC requirements.

B. Coordinate with the building structural system and with other electrical installation.

C. Raceway Supports: Comply with the NEC and the following requirements:

1. Conform to manufacturer's recommendations for selection and installation of supports.
2. Strength of each support shall be adequate to carry present and future load multiplied by a safety factor of at least four. Where this determination results in a safety allowance of less than 200 lbs., provide additional strength until there is a minimum of 200 lbs safety allowance in the strength of each support.
3. Install individual and multiple (trapeze) raceway hangers and riser clamps as necessary to support raceways. Provide U-bolts, clamps, attachments, and other hardware necessary for hanger assembly and for securing hanger rods and conduits.
4. Support parallel runs of horizontal raceways together on trapeze-type hangers. All supporting rods shall be rigid. Aircraft cable and other similar non-rigid cable shall not be used to support horizontal conduit.
5. Support individual horizontal raceways by separate pipe hangers. Spring steel fasteners may be used in lieu of hangers only for 1 1/2 inch and smaller raceways serving lighting and receptacle branch circuits above suspended ceilings only. For hanger rods with spring steel fasteners, use ¼-inch diameter or larger threaded steel. Use spring fasteners that are specifically designed for supporting single conduits or tubing.
6. Space supports for raceway in accordance with NEC.
7. Support exposed and concealed raceway within 1 foot of an unsupported box and access fittings. In horizontal runs, supports at the box and access fittings may be omitted where box or access fittings are independently supported and raceway terminals are not made with chase nipples of threadless box connectors.
8. In vertical runs, arrange support so the load produced by the weight of the raceway and the enclosed conductors is carried entirely by the conduit supports with no weight load on raceway terminals.

D. Vertical Conductor Supports: Install simultaneously with installation of conductors (i.e., strain reliefs).

1. Support shall be at each individual conductor.

E. Miscellaneous Supports: Support miscellaneous electrical components as required to produce the same structural safety factors as specified for raceway supports. Install metal channel racks for mounting cabinets, panelboards, disconnects, control enclosures, pull boxes, junction boxes, transformers, and other devices.

F. In open overhead spaces, cast boxes threaded to raceways need not be supported separately except where used for fixture support; support sheet metal boxes directly from the building structure or by bar hangers. Where bar hangers are used, attach the bar to the raceways on opposite sides of the box and support the raceway with an approved type of fastener not more than 24 inches from the box.

G. Sleeves: Install in concrete slabs and walls and all other fire-rated floors and wall for raceways and cable installations. For sleeves through fire-rated wall or floor construction, apply UL-listed firestopping sealant in gaps between sleeves and enclosed conduits and cables in accordance with “Fire Stopping” requirement of Division 7.

H. Conduit Seals: Install seals for conduit penetrations of slabs on grade and exterior walls below grade and where indicated. Tighten sleeve seal screws until sealing grommets have expanded to form watertight seal.

I. Fastening: Unless otherwise indicated, fasten electrical items and their supporting hardware securely to the building structure, including but not limited to conduits, raceways, cables, cable trays, cabinets, panelboards, transformers, boxes, disconnect switches, and control components in accordance with the following:

1. Fasten by means of wood screws or screw-type nails on wood, toggle bolts on hollow masonry units, concrete inserts or expansion bolts on concrete or masonry, and machine screws, welded threaded studs, or spring-tension clamps on steel. Do not weld conduit, pipe straps, or items other than threaded studs to steel structures. In partitions or light steel construction, use sheet metal screws.
2. Holes cut to depth of more than 1 1/2 inches in reinforced concrete beams or to depth of more than ¾ inch in concrete shall not cut the main reinforcing bars. Fill holes that are not used.
3. Ensure that the load applied to any fastener does not exceed 25 percent of the proof test load. Use vibration- and shock-resistant fasteners for attachments to concrete slabs.

J. Provide a manufactured support system for horizontally routed rooftop conduits consisting of the following:

1. A mounting base, nominal 6-7/16” high x 6” wide x 9-1/2” long, manufactured from 100% recycled rubber, UV resistant.
2. The base shall be combined with a 2-7/16” high, 12 gauge galvanized steel U-channel, fastened to the base, to form the basic support system. A single base with U-channel shall provide an ultimate load capacity of 500 lbs per linear foot.
3. The base shall be suitable for mounting on any type of roofing material or other flat surfaces.
4. Provide multiple bases with length of U-channel required at any location where there are multiple runs of parallel conduits.
5. Provide conduit clamps and straps that are designed for fastening to U-channels. All fastening hardware shall be hot-dip galvanized steel or equivalent ASTM recognized coating approved for exterior applications.
6. Include, with the manufacturers’ product data in the shop drawing submittal, a rooftop conduit layout drawing that indicates routing, the location of the conduit supports and the anticipated total weight at typical multiply conduit locations.

K. TESTS: Test pull-out resistance of one of each type, size, and anchorage material for the following fastener types:

1. Expansion anchors.
2. Toggle bolts.

L. Provide all jacks, jigs, fixtures, and calibrated indicating scales required for reliable testing. Obtain the structural Engineer's approval before transmitting loads to the structure. Test to 90 percent of rated proof load for fastener. If fastening fails test, revise all similar fastener installations and retest until satisfactory results are achieved.

END OF SECTION

This page is intentionally left blank.

SECTION 26 05 33 - RACEWAYS AND BOXES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this section.

B. Requirements of the following Division 26 Sections apply to this Section:

1. “Electrical Requirements.”
2. “Basic Material and Methods”

1.2 SUMMARY

A. Drawings are diagrammatic. All bends, boxes, fittings, couplings are not necessarily shown. Supply as necessary to comply with the National Electric Code.

B. Provide complete raceway systems for all conductors including control wiring and low-voltage wiring unless otherwise noted.

C. This Section includes raceways for electrical wiring. Types of raceways, boxes and fittings in this section include the following:

1. Electrical metallic tubing (EMT).
2. Flexible metal conduit.
3. Intermediate metal conduit (IMC).
4. Liquid-tight flexible conduit.
5. Rigid metallic conduit (RMC).
6. Metal clad cable (MC).
7. Surface raceways.
8. Rigid non-metallic conduit.
9. Electrical non-metallic tubing (ENT)
10. Wireway.
11. Outlet boxes.
12. Junction boxes.
13. Pull boxes.
14. Bushings.
15. Locknuts.
16. Knockout closures.

D. Related Sections: The following section contains requirements that relate to this section:

1. Division 26 Section “Raceway and Boxes” for conduit connectors, fittings, and couplings.
2. Division 7 Section “Firestopping” for conduit penetrations through rated walls and slabs.

E. Section only applies for electrical systems to be installed within raceways. This excludes beverage piping and pneumatic systems pulled within raceways.

1.3 SUBMITTALS

A. General: Submit the following in accordance with Conditions of contract and Division 1 Specification Section.

B. Product Data for the following products:

1. Raceways and fittings.
2. Wireways and fittings.
3. Boxes and fittings.

C. Installation Instructions: Manufacturer's written installation instructions for wireway, surface raceway, and nonmetallic raceway products.

1.4 QUALITY ASSURANCE

A. Electrical Component Standard: Components and installation shall comply with NFPA 70 "National Electrical Code."

B. NEMA Compliance: Comply with applicable requirements of NEMA standards pertaining to raceways.

C. UL Compliance and Labeling: Comply with applicable requirements of UL standards pertaining to electrical raceway systems. Provide raceway products and components listed and labeled by UL.

D. Manufacturers: Firms regularly engaged in manufacture of electrical boxes and fittings, of types, sizes, and capacities required, whose products have been in satisfactory use in similar service for not less than five years.

E. Installer's Qualifications: Firms with at least five years of successful installation experience on projects utilizing electrical boxes and fittings similar to those required for this project.

F. NEC Compliance: Comply with NEC as applicable to construction and installation of electrical wiring boxes and fittings.

G. UL Compliance: Comply with applicable requirements of UL 50, UL 514-Series, and UL 886 pertaining to electrical boxes and fittings. Provide electrical boxes and fittings which are UL-listed and labeled.

H. NEMA Compliance: Comply with applicable requirements of NEMA Standards/Pub No.'s OS1, OS2 and PUB 250 pertaining to outlet and device boxes, covers and box supports.

I. Federal Specification Compliance: Comply with applicable requirements of FS W-C 586, "Electrical Cast Metal Conduit Outlet Boxes, Bodies, and Entrance Caps."

PART 2 - PRODUCTS

2.1 METAL CONDUIT AND TUBING

A. Rigid Steel Conduit: ANSI C80.1

B. PVC Coated Rigid Galvanized Steel Conduit: ANSI C80.1, UL6 & NEMA RN-1 2018

C. Intermediate Steel Conduit: UL 1242.

D. Electrical Metallic Tubing and Fittings: ANSI C80.3.

E. Flexible Metal Conduit: UL 1, zinc-coated steel.

F. Liquid-tight Flexible Metal Conduit and Fittings: UL 360.

2.2 METAL CLAD CABLE, TYPE MC

A. The multi-conductor metal clad cable shall comply with UL 1569 “Metal Clad, Type MC,” UL 83 “Thermoplastic Insulated Wires and Cables” Federal Specification J-C-30B “Wire and Cable,” Local and National Electrical Codes.

B. The metal clad cable shall be THHN insulation, copper conductors in sizes #12 through #8 AWG only for continuous operation at a maximum conductor temperature of 90 degree C dry.

C. These cables shall bear appropriate Underwriters Laboratories labels for metal clad cable and be suitable for use as branch circuits in both exposed and concealed work in accordance with applicable sections of the National Electrical Code.

D. An insulated grounding conductor sized in accordance with Table 5.3 Underwriter’s Standard UL 1569 shall be cabled with the circuit conductors and shall be identified in compliance with Section 29 of UL 1569. The grounding conductor shall not be smaller than size indicated in NEC Article Table 250.122.

E. A galvanized steel or aluminum armor shall be applied over the inner cable assembly with a positive interlock in compliance with Section 10 of UL 1569. MC cable with a PVC jacket shall not be permitted to be installed in slabs.

2.3 NONMETALLIC CONDUIT AND DUCTS

A. Rigid Nonmetallic Conduit (RNC): NEMA TC 2 and UL 651, Schedule 40 or 80 PVC.

B. PVC Conduit and Tubing Fittings: NEMA TC 3; match to conduit or conduit/tubing type and material.

C. Conduit, Tubing and Duct Accessories: Types, sizes and materials complying with manufacturer’s published product information. Mate and match accessories with raceway.

D. Electrical non-metallic tubing (ENT): NEMA TC13 and UL1653.

2.4 PVC COATED RIGID GALVANIZED STEEL CONDUIT

A. PVC Coated Rigid Galvanized Steel Conduit shall comply with ANSI C80.1, C80.5, UL6 and NEMA RN-1.

B. The Rigid Galvanized Steel Conduit shall be hot dipped galvanized inside and out and shall have hot dipped galvanized threads.

C. The external PVC coating shall be a nominal 40 mils of PVC coating with 2mils of interior urethane coating.

D. The factory applied hot dipped galvanizing shall not be disturbed in any fashion prior to the application of PVC coatings applied during manufacturing.

E. The PVC coated RGS Conduit shall comply with all UL listings providing the hot dipped galvanized coating as the primary means of corrosion protection and the PVC shall be listed as the secondary means of corrosion protection.

2.5 CONDUIT BODIES AND FITTINGS

A. General: Types, shapes, and sizes as required to suit individual applications and NEC requirements. Provide matching gasketed covers secured with corrosion-resistant screws.

B. Metallic Conduit and Tubing: Use metallic conduit bodies. Use bodies with threaded hubs for threaded raceways.

C. EMT Conduit Bodies 1 Inch and Smaller: Use bodies with steel set screw connectors and couplings for interior applications and steel compression gland connectors and couplings for exterior applications.

D. EMT Conduit Bodies 1 Inch and Larger: Use bodies with steel set screw connectors and couplings for interior applications and steel compression gland connectors and couplings for exterior applications.

E. Nonmetallic Conduit and Tubing: Use nonmetallic conduit bodies conforming to UL514B.

F. PVC Coated RGS Conduit Bodies: Conduit bodies shall have a nominal 40mils of PVC and 2mils of interior urethane and shall be NEMA 4X listed with encapsulated stainless-steel screws.

G. Liquid-Tight Flexible Conduit Fittings: With threaded grounding cone, steel, nylon or equal plastic compression ring, and a gland for tightening. Either steel or malleable iron only with insulated throats and male thread and locknut or male bushing with or without O-ring seal. Each connector shall provide a low resistance ground connection between the flexible conduit and the outlet box, conduit or other equipment to which it is connected.

H. Bushings: Insulated type, designed to prevent abrasion of wires without impairing the continuity of the conduit grounding system, for rigid steel conduit, IMC and EMT, larger than 3/4” size.

I. Expansion Fittings: Each conduit that is buried in or secured to the buildings construction on opposite sides of a building expansion joint and each long run of exposed conduit that may be subject to excessive stresses shall be provided with an expansion fitting. Expansion fittings for rigid steel conduit shall be hot-dipped galvanized malleable iron with factory installed packing and a grounding ring and internal bonding jumper. Expansion fittings for rigid non-metallic conduit shall be of the short type in runs 25’ or less, and the long type in runs 26’ to 80’. The long type shall be a two piece barrel and piston joint, providing 6” of the total movement range in 3/4” through 6” conduit sizes. The short type shall be a one piece, coupling with O-ring, providing 2” of total movement range in 3/4” to 2” conduit sizes.

J. Seal Off Fittings: Refer to section 26 05 02 for additional requirements.

K. Sleeves for Conduit Penetration: Refer to section 26 05 02 for additional requirements.

2.6 WIREWAYS

A. General: Electrical wireways shall be of types, sizes, and number of channels as indicated. Fittings and accessories including but not limited to couplings, offsets, elbows, expansion joints, adapters, hold-down straps, and end caps shall match and mate with wireway as required for complete system. Where features are not indicated, select to fulfill wiring requirements and comply with applicable provisions of NEC.

B. Wireway covers shall be hinged type.

2.7 SURFACE RACEWAYS

A. General: Sizes and channels as indicated on drawings. Provide fittings that match and mate with raceway. Provide internal barriers for areas with power and communications sections.

B. Surface Metal Raceway: Construct of two piece galvanized steel with snap-on covers, with 9/32-inch mounting screw knockouts in base approximately 8 inches o.c. Finish with manufacturer’s standard prime coating suitable for painting. Provide raceways of types suitable for each application required. Sizes 1-3/4” H x 4-3/4” W.

C. Accessories:

1. Couplings for joining raceway sections.
2. Wire clips for conductors.
3. Blank end fittings.
4. Circuit breaker housings for single pole breakers.
5. Device brackets for single or two gang devices.
6. Combination receptacle and tele/data outlet covers.
7. Outlet boxes with hubs for conduit connectors.

2.8 FABRICATED MATERIALS - BOXES

A. Outlet Boxes: Provide galvanized flat rolled sheet-steel outlet wiring boxes, of shapes, cubic inch capacities, and sizes (minimum 4-inch square, 1 ½-inch deep), including box depths as required, suitable for installation at respective locations. Construct outlet boxes with mounting holes, and with cable and conduit-size knockout openings in bottom and sides. Provide boxes with threaded screw holes, with corrosion-resistant cover and grounding screws for fastening surface and device type box covers, and for equipment type grounding.

1. Outlet Box Accessories: Provide outlet box accessories as required for each installation, including box supports, mounting ears and brackets, wallboard hangers, box extension rings, fixture studs, cable clamps and metal straps for supporting outlet boxes, which are compatible with outlet boxes being used to fulfill installation requirements for individual wiring situations. Choice of accessories is Installer's code-compliance option.

B. Device Boxes: Provide galvanized coated flat rolled sheet-steel non-gangable device boxes, of shapes, cubic inch capacities, and sizes (minimum 4-inch square, 1 ½-inches deep), including box depths as indicated, suitable for installation at respective locations. Construct device boxes for flush mounting with mounting holes, and with conduit-size knockout openings in bottom and ends, and with threaded screw holes in end plates for fastening devices. Provide conduit connectors and corrosion-resistant screws for equipment type grounding.

1. Device Box Accessories: Provide device box accessories as required for each installation, including mounting brackets, device box extensions, switch box supports, plaster ears, and plaster ears, and plasterboard expandable grip fasteners, which are compatible with device boxes being utilized to fulfill installation requirements for individual wiring situations. Choice of accessories is Installer's code-compliance option.

C. Raintight Outlet Boxes: Provide corrosion-resistant cast-metal raintight outlet wiring boxes, of types, shapes and sizes, including depth of boxes, with threaded conduit holes for fastening electrical conduit, cast-metal face plates with spring-hinged watertight caps suitably configured for each application, including face plate gaskets and corrosion-resistant plugs and fasteners.

D. Junction and Pull Boxes: Provide code-gauge sheet steel junction and pull boxes, with screw-on covers; of types, shapes and sizes, to suit each respective location and installation; with welded seams and equipped with stainless-steel nuts, bolts, screws, and washers. Pull boxes installed in finished spaces must be flush-mounted cabinets provided with trim, hinged door and flush latch and lock to match flush-mounted panelboard trim. Provide galvanized code-gauge steel where required for outdoor exposure.

E. Exterior junction or pull boxes, flush with grade:

1. All exterior pull box locations shall be submitted and approved by landscape architect prior to installation.
2. Junction or pull box to be mounted flush with grade shall be polymer composite raintight with screw cover lids. Box dimensions shall be 30"W x 48"L x 36"D. Covers shall be polymer composite suitable for pedestrian traffic secured to box with stainless-steel screws. Box to be furnished with continuous neoprene gasket to seal cover. Conduit entry shall be on side of box with bell ends.

F. Bushings, Knockout Closures and Locknuts: Provide corrosion-resistant box knockout closures, conduit locknuts and malleable iron conduit bushings, offset connectors, of types and sizes, to suit respective installation requirements and applications.

PART 3 - EXECUTION

3.1 WIRING METHOD

A. Outdoors: Use the following wiring methods:

1. Exposed: Intermediate metal conduit, rigid steel conduit, raintight box.
2. Concealed: Intermediate metal conduit, rigid steel conduit.
3. Underground, Single Run: Rigid non-metallic conduit. PVC coated GRC 90° elbows.
4. Underground, Grouped: Rigid non-metallic conduit. PVC coated GRC 90° elbows.
5. Connection to Vibrating Equipment including transformers, pneumatic or electrical solenoid, and motor-operated equipment: Liquid-tight flexible metal conduit.

B. Indoors: Use the following wiring methods:

1. Exposed (below 10 ft. to floor): Intermediate metal conduit, rigid steel conduit.
2. Exposed (above 10ft. or in electrical room): Electrical metallic tubing.
3. Concealed: Electrical metallic tubing.
4. Concealed: Metal clad cable will be allowed as final branch wiring of receptacles (maximum total length of 25’ from homerun J-box or hard piped J-box to first outlet on circuit). MC is not allowed for use as a feeder. MC is not allowed for homeruns to panels, connections to mechanical equipment. Maximum conductor size is in MC cable #8 AWG. MC is acceptable for final light fixture connection, maximum 6’ length.
5. Connection to Vibrating Equipment including transformers, pneumatic or electrical solenoid, and motor-operated equipment: Flexible metal conduit.
6. Connection to Vibrating Equipment in Moist/Humid or Corrosive Atmosphere including pneumatic or electric solenoid, and motor-operated equipment: Liquid-tight flexible metal conduit.
7. Within concrete slabs: Rigid non-metallic conduit. PVC coated MC cable and ENT is not allowed. Homeruns shall be in conduit. Maximum sizes and locations as approved by the Structural Engineer.
8. Raceway mounted to underside of metal-corrugated sheet roof decking shall be Rigid Metal Conduit or intermediate Metal Conduit.
9. Exposed Wet Locations: Intermediate metal conduit, rigid steel conduit, raintight box.

    a. Provide conduit bodies or exterior boxes with a minimum of 1/8” drain. Drain shall be located to allow exterior raceway system to drain.

10. Corrosive Environment, including areas where pool equipment is installed or areas where chemicals are stored: Rigid Metal Conduit, Intermediate Metal Conduit, PVC (where not installed in a plenum) or Fiberglass.

3.2 INSTALLATION OF RACEWAYS

A. General: Install electrical raceways in accordance with manufacturers’ written installation instructions, applicable requirements of NEC, and as follows.

B. Electrical system layouts indicated on drawings are generally diagrammatic, but shall be followed as closely as actual construction and work of other trades will permit. Govern exact routing of raceways and locations of outlets by structure and equipment served. Take all dimensions from architectural drawings.

C. All home runs to panelboards are indicated as starting from the outlet nearest to the panel and continuing in the general direction of that panel. Continue such circuits to panel as though routes were completely indicated.

D. Avoid cutting and boring holes through structure or structural members wherever possible. Obtain prior approval of the Architect, and conform to all structural requirements when cutting or boring structure.

E. Furnish and install all necessary hardware, hangers, blocking, brackets, bracing, runners, etc., required for equipment specified under this Section.

F. Minimum size conduit shall be 3/4” for power circuits and 1” for telecommunications devices.

G. Conceal conduit and EMT, unless indicated otherwise, within finished wall, ceilings, and floors. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot water pipes. Install raceways level and square and at proper elevations.

H. Elevation of Raceway: Where possible, install horizontal raceway runs above water and steam piping.

I. Complete installation of electrical raceways before starting installation of conductors within raceways.

J. Provide supports for raceways as specified elsewhere in Division 26 and in accordance with NEC and local authorities’ seismic requirements.

K. Prevent foreign matter from entering raceways by using temporary closure protection.

L. PVC coated rigid galvanized steel conduit systems: Provide onsite installation training course by company representative. The representative shall conduct onsite training course to qualify for the installation certificate. After the onsite training installation, the representative shall then register the installer in his data base and provide certification for installation.

M. Protect stub-ups from damage where conduits rise from floor slabs. Arrange so curved portion of bends is not visible above the finished slab. All elbow penetration through the slab shall be PVC coated rigid metallic conduit Ells. Where elbows end below the slab, extend PVC coated rigid conduit a minimum of 6 inches above the finished slab.

N. Make bends and offsets so the inside diameter is not effectively reduced. Unless otherwise indicated, keep the legs of a bend in the same plane and the straight legs of offsets parallel.

O. Use raceway fittings that are of types compatible with the associated raceway and suitable for the use and location. For intermediate steel conduit, use threaded rigid steel conduit fittings except as otherwise indicated.

P. Run concealed raceways with a minimum of bends in the shortest practical distance considering the type of building construction and obstructions except as otherwise indicated.

Q. Raceways embedded in slabs shall only be permitted with the strict written approval of the Structural Engineer and Architect. For bidding purpose, conduit shall not be permitted in slab.

R. Install exposed raceways parallel and perpendicular to nearby surfaces or structural members and follow the surface contours as much as practical. All exposed conduit runs shall be approved by the Architect prior to installing.

S. All exposed conduits in public areas shall be painted to match surrounding walls. Verify exact color with the Architect. Coordinate painting of all exposed conduits with Construction Manager / General Contractor.

T. Run exposed, parallel, or banked raceways together. Make bends in parallel or banked runs from the same center line so that the bends are parallel. Factory elbows may be used in banked runs only where they can be installed parallel. This requires that there be a change in the plane of the run such as from wall to ceiling and that the raceways are of the same size. In other cases, provide field bends for parallel raceways. All exposed conduit routing shall be approved by the Architect prior to installing.

U. Join raceways with fittings designed and approved for the purpose and make joints tight. Where joints cannot be made tight, use bonding jumpers to provide electrical continuity of the raceway system. Make raceway terminations tight. Where terminations are subject to vibration, use bonding bushings or wedges to assure electrical continuity. Where subject to vibration or dampness, use insulating bushings to protect conductors. Use expansion fittings at building expansion joints.

V. Tighten set screws of threadless fittings with suitable tool.

W. Terminations: Where raceways are terminated with locknuts and bushings, align the raceway to enter squarely and install the locknuts with dished part against the box. Where terminations cannot be made secure with one locknut, use two locknuts, one inside and one outside of the box. All conduit connections to junction boxes shall have insulated bushings.

X. Where terminating in threaded hubs, screw the raceway or fitting tight into the hub so the end bears against the wire protection shoulder. Where chase nipples are used, align the raceway so the coupling is square to the box, and tighten the chase nipple so no threads are exposed.

Y. Install pull wires in empty raceways. Use No. 14 AWG zinc-coated steel or monofilament plastic line having not less than 200-lb tensile strength. Leave no less than 12 inches of slack at each end of the pull wire.

Z. Install raceway sealing fittings in accordance with the manufacturer’s written instructions. Fitting should come complete with O-ring gasket. Locate fittings at suitable, approved, accessible locations and fill them with UL-listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings at the following points and elsewhere as indicated:

1. Where conduits pass from warm locations to cold locations, such as the boundaries of refrigerated spaces, air-conditioned spaces and walk-in coolers.
2. Where required by the NEC.

AA. Stub-up Connections: Extend conduits through concrete floor for connection to freestanding equipment with an adjustable top or coupling threaded inside for plugs and set flush with the finished floor. Extend conductors to equipment with rigid steel conduit; flexible metal conduit may be used 6 inches above the floor. Where equipment connections are not made under this contract, install screwdriver-operated threaded flush plugs flush with floor.

BB. Flexible connection: Use length (maximum of 6 ft.) of flexible conduit for recessed and semi-recessed lighting fixtures, for equipment subject to vibration, noise transmission, or movement; and for all motors. Use liquid-tight flexible conduit in wet locations. Install separate equipment grounding conductor across flexible connections.

CC. Install nonferrous conduit or tubing for circuits operating above 60 Hz.

DD. PVC externally coated rigid steel conduit: Use only fittings approved for use with that material. Patch all nicks and scrapes in PVC coating after installing conduit.

EE. All underground conduits shall be installed a minimum of 48 inches below finish grade for medium-voltage feeders and 30 inches for 480-Volt feeders. All other conduits shall be installed in accordance with the NEC and coordinated depth with other trades.

FF. All medium-voltage ductbanks shall be encased in concrete.

GG. Grounding: Install a separate green equipment grounding conductor in all raceways from the panelboard/junction box supplying the raceway to the receptacle or equipment ground terminals. Conduits will not be permitted as a ground conductor.

HH. Emergency and standby feeder raceways that are not concealed in the electrical room or in sprinkled spaces shall be wrapped in a 2-hour protected fire wrap (MFR: 3M interam wrap or approved equal) or wiring shall be 2-hour protected and UL listed for that purpose.

II. Furnish and install all raceways from elevator machine room to fire command center for elevator status.

JJ. Clearances: All electrical raceways shall be routed to maintain appropriate clearances from low-voltage raceways per NEC, ANSI/EIA/TIA, and BICSI requirements. Provided below are minimum requirements of key components that shall be maintained. For any instances where field conditions do not allow for the minimum clearances, the Contractor shall notify the Architect and Engineer so that an acceptable solution can be coordinated.

1. 120V Power Conduits: 6 inches (150mm)
2. 208V and Higher Power: 24 inches (600mm)
3. Lighting System: 12 inches (300mm)
4. Transformers: 48 inches (1200mm)
5. Motors and Fans: 48 inches (1200mm)
6. Other Interfering Sources to be field verified and coordinated by Contractor with Architect and Engineer.

KK. Support: All electrical raceways shall be independently supported. Support from suspended ceiling elements is not permitted.

3.3 INSTALLATION OF ELECTRICAL BOXES AND FITTINGS

A. General: Install electrical boxes and fittings in accordance with manufacturer's written instructions, applicable requirements of NEC and NECA's "Standard of Installation," and in accordance with recognized industry practices to fulfill project requirements.

B. Dimensions unless shown on drawings are given below and are from finished floor to center line of outlets unless noted otherwise. Adjust heights of outlets in masonry walls to correspond with consistent brick or block course. Outlets in block walls shall be installed in core of block.

Wall Switches	4’ - 0” (to top of box)
Convenience outlets	1’ - 4” (to bottom of box) – gyp or 8” block 1’ – 6” (to bottom of box) – 6” block
Above counter wall outlet	0’ - 8” (above counter to top of box, maximum 44” AFF, field verify height of backsplash)
Panelboards wall mounted	6’ - 6” (to top of back box)
Wall phone outlet	4’ - 0” (to top of box)
Tele/Data outlets	1’ - 4” (to bottom of box) – gyp or 8” block 1’ – 6” (to bottom of box) – 6” block
Fire alarm horns, speakers	ceiling or wall
Fire alarm pull stations	4’ - 0” (to top of device)
Fire alarm strobes	6’ - 8” or 6” below ceiling (whichever is lower)
Television outlets	Refer to A/V or architectural drawing.

Confirm final location and heights of all outlets, wall switches, and television outlets with architectural drawings and furniture plans prior to installation.

C. Exact location of outlets and equipment shall be governed by structural conditions and obstructions or other equipment items. When necessary, relocate outlets so that when fixtures or equipment are installed, they will be symmetrically located according to room layout and will not interfere with other work or equipment. Verify final location of all outlets, panels, equipment, etc., with the Architect/Engineer.

D. Coordinate installation of electrical boxes and fittings with wire/cable, wiring devices, and raceway installation work.

E. Provide zinc-coated or cadmium-plated sheet steel outlet boxes not less than 4” octagonal or square, unless otherwise noted. Equip fixture outlet boxes with 3/8” no-bolt fixture studs. Where fixtures are mounted on or in an accessible type ceiling, provide a junction box and extend flexible conduit to each fixture. Outlet boxes in finished ceilings or walls shall be fitted with appropriate covers, set to come flush with the finished surface. Where more than one switch or device is located on one point, use gang boxes and covers unless otherwise indicated. Sectional switch boxes or utility boxes will not be permitted.

F. Provide tile box or a 4” square box with tile ring in masonry walls which will not be plastered or furred, or where “dry-wall” type materials are applied. Through the wall type boxes are not permitted. Install minimum 12” lateral separation for back to back boxes.

G. Provide outlets in rain tight box with metallic “in use” covers for interior and exterior locations exposed to weather or moisture.

H. Provide rain tight box for all interior, exterior and non-conditioned locations exposed to weather or moisture. This includes boxes located under overhangs not directly exposed to moisture.

I. Surface-mounted devices are to be mounted in cast type boxes with gasketed covers: (Crouse-Hinds FS/FD or equal).

J. Provide knockout closures to cap unused knockout holes where blanks have been removed.

K. Install electrical boxes in those locations which ensure ready accessibility to enclosed electrical wiring.

L. Electrical Contractor to provide access panels for electrical boxes which are code required to have accessibility.

M. Installing boxes back-to-back in walls shall not be permitted. Provide no less than 12 inches (150 mm) of separation.

N. Position recessed outlet boxes accurately to allow for surface finish thickness.

O. Avoid using round boxes where conduit must enter box through side of box, which would result in difficult and insecure connections when fastened with locknut or bushing on rounded surfaces.

P. Fasten electrical boxes firmly and rigidly to substrates, or structural surfaces to which attached, or solidly embedded electrical boxes in concrete or masonry.

Q. Provide electrical connections for installed boxes.

R. Exterior junction or pull boxes shall be mounted flush with grade, unless noted otherwise or indicated to be above ground on the drawings. Boxes shall be surrounded on all sides with 6 inches minimum of concrete. Top of concrete shall flush with grade. Seal all conduit entries into box with duct seal to prevent entrance of moisture, after conductors are installed.

S. Tap and splices, where permitted by these specifications within exterior junction boxes, shall be performed with an encapsulating watertight splice or tap kit which insulates and moisture seals the connection. Kit shall consist of the appropriate size and type mold, encapsulating resin and end sealing tape.

T. Subsequent to installation of boxes, protect boxes from construction debris and damage.

U. Provide a standard access panel having a hinged metal door neatly fitted into a flush metal trim, where a junction box or equipment is located above non-accessible ceilings or behind finished walls. Coordinate location and type with the Architect.

V. Outlets except over counters, benches, special equipment, baseboards, fin tube radiators, etc., or at wainscoting, shall be at a height to prevent interference to service equipment, or as noted on drawings.

3.4 GROUNDING

A. Upon completion of installation work, properly ground electrical boxes and demonstrate compliance with requirements.

3.5 ADJUSTING AND CLEANING

A. Upon completion of installation of raceways, inspect interiors of raceways; clear all blockages and remove burrs, dirt, and construction debris.

END OF SECTION

SECTION 26 05 43 - UNDERGROUND DUCTS, RACEWAYS AND MANHOLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and General Provisions of Contract.

B. Requirement of the following Division 26 Sections apply to this section:

1. 26 05 00 Electrical Requirements
2. 26 05 02 Basic Material and Methods
3. 26 05 03 Manufacturers
4. 26 05 33 Raceways and Boxes
5. 26 05 53 Identification

C. Excavating, backfilling and Compacting and Division 3, concrete.

D. All excavation is unclassified.

E. Definitions:

1. Engineer: Soils Engineer employed by Owner and empowered to undertake necessary inspections and approvals.
2. Unclassified excavation: Excavate and grade all materials that can be removed without drilling or blasting.

1.2 SUMMARY

A. Furnish all labor, materials, tools, equipment, and services for all underground service and manholes as indicated, in accordance with provisions of Contract Documents.

B. Completely coordinate with work of all other trades.

C. Although such work is not specifically shown or specified, furnish, and install all supplementary or miscellaneous items, appurtenances and devices incidental to or necessary for a sound, secure and complete installation.

D. Underground work for the serving electric and telephone utilities shall comply with the utilities' requirements and standards.

1.3 SUBMITTALS

A. Product data for the following: Electrical and Telecommunication Manholes, Duct Spacers. Include all hardware items supplied and load rating for equipment.

B. Submit manufacturer's product data for the following:

1. Precast concrete manholes and associated hardware.
2. Precast concrete pullboxes and hand holes.
3. Precast concrete transformer pads.

C. Shop Drawings detailing all manholes and pull boxes. Provide physical dimensions with locations and conduit routings.

D. Test reports as required for compaction and concrete work in Divisions 2, 3, and 31.

E. Submit pulling tension calculations for all underground feeders.

1.4 QUALITY ASSURANCE

A. Compaction density test: ASTM D1557.

B. Owner will hire an independent soils laboratory to conduct in-place moisture-density tests to ensure that all work complies with this specification.

1. Notify Construction Manager or Owner's representative at least 2 weeks prior to anticipated date of testing.
2. Contractor will pay an additional cost if work is delayed due to their failure to notify Owner's agent as specified above.

C. Comply with all aspects of "Safety Rules & Regulations for Excavation: as promulgated by the state in which excavation will occur.

D. Comply with code requirements of the authority having jurisdiction, as applicable to the installation and construction of underground electrical work.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Store conduit to avoid warping or deterioration.

B. Store non-metallic (PVC) conduit and fittings on a flat surface in an area that is protected from direct sunlight.

PART 2 - PRODUCTS

2.1 DUCT SYSTEM

A. Duct System: Multiple and single, conduits completely encased in concrete.

1. Separators: Plastic or other non-metallic, non-decaying material.
2. Concrete: 3000 PSI. Conform to Division 3 requirements.

B. Pull Wire: No. 9 galvanized iron, or heavy nylon cord, free of kinks and splices.

2.2 MANHOLES

A. Provide complete precast reinforced concrete manholes where indicated, 4'-0" x 6'-6" x 7' deep minimum dimensions unless noted larger on the drawings.

B. Electric Manholes: Types as indicated:

1. Concrete: 4500 PSI. Conform to Division 3 requirements.
2. Cover and frame: 30" diameter, gray cast iron with machine finished seat for perfect joint between traffic rated cover and frame.
3. Provide floor drain with grate. 10" diameter x 6" deep dry sump. Provide cast metal frame and grille cover over sump.
4. Provide cable racks, ladder rungs.
5. Provide conduit entries on four sides.
6. Install pulling irons with ends hooked over reinforcing bars.
7. Provide end bells in all duct entrances.

C. Cable Racks: Hot-dipped Galvanized, mounted on wall.

1. Equipment with minimum of 8 adjustable hooks; minimum 2 spare hooks on each rack.
2. Insulators: Best quality, high glazed porcelain; provide for each hook.
3. Space racks so each end of splices is supported horizontally.

D. Ladder Rungs: Galvanized, 12" x 12" x 3/4" diameter.

1. Set with 7" clearance from rung to wall.

E. Ground Rods: (2) 3/4" x 10' long, copper weld.

F. Identification: Cast system designation in covers in 2" size letters as directed.

1. Primary Power: HIGH VOLTAGE.
2. Secondary Voltage: ELECTRICAL.
3. Telephone System: TELEPHONE.
4. Communication System: SIGNAL.
5. Others as directed. Obtain Owner's approval for designations.

G. For manholes provided for utility conductors, comply with additional requirements of utility company and obtain approvals.

2.3 PULL BOXES

A. Site Pull Boxes

1. Site grass landscape areas pull boxes shall be constructed of HDPE. Box to be rated Tier 22.
2. Site shrub and tree landscape areas pull boxes shall be constructed of HDPE. Box to be rated Tier 8.
3. Pull boxes located in concrete drives, sidewalks, etc. shall be precast type with HS-20 rated drive over lids.
4. All boxes in landscape areas to have color selected by architect.

2.4 PRECAST TRANSFORMER PADS:

A. Provide dimensions, configurations, and accessories as indicated on drawings and as required.

B. For utility company transformers, comply with utility company requirements.

PART 3 - EXECUTION

3.1 INSTALLATION OF MANHOLES

A. Determine exact location of each manhole after careful consideration has been given to location of other utilities, grading, and paving.

1. Do not begin construction until location of each manhole has been approved by Architect/Engineer.

B. Construct manholes of type indicated in accord with applicable details.

1. Mix, place and cure concrete or set precast unit on non-expansive soil bed in accord with Division 3 requirements.
2. Set manholes on 12” deep, minimum, gravel or sand bed with top of manholes 12” minimum below finished grade. In exterior paved areas, set cover flush with paving, with paving sloping away from manhole. In unpaved areas, locate manholes so that runoff water will not drain to manhole. Set cover 2” above finished grade and provide a 6” thick by 5’ square concrete apron centered on the cover, and sloped to the edge, away from the cover.

C. Set frames and cover:

1. Paint exterior with 2 coats asphaltic paint after inspection and approval by Architect/Engineer, and before setting.
2. In paved areas, set top of manhole covers flush with finished surface of paving.
3. In unpaved areas, set top of manhole covers approximately ½” above finished grade.
4. Where final grades are higher than top of manhole, install sufficient number of courses of grade rings between top of manhole and manhole frame to elevate manhole cover to final grade level.

D. Install cable racks, ladder rungs, and cable pulling irons in manholes.

E. Drive 2 ground rods into earth not less than 9’ before manhole floor is placed.

1. Extend ground rods approximately 6” projection above floor of manhole and connected to ground conductor and cable shield.
2. Provide watertight seal around ground rod.

F. Caulk between all sections of manholes and coat exteriors with weatherproof compound.

3.2 DUCT BANK

A. Form all duct banks in square or rectangular fashion as shown, and place concrete so that voids around ducts are filled.

B. Provide minimum concrete thickness between duct of 2 inches.

C. Adjust final slopes on-site to coordinate with utilities and structure.

D. Install drain assembly with saddle cutouts for each conduit. Tape drain assembly to each conduit to prevent entrance of concrete. Band drain assembly with ½-inch stainless-steel straps to conduit assembly to prevent mechanical displacement. Connect to (piping drain) washed gravel sump 36-inch square by 36-inches deep.

E. Install on undisturbed soil where possible. Use pit run gravel and sand, placed in 8-inch lifts and compacted for backfill.

F. After installation, clean and swab ducts.

G. Install galvanized steel pullwires in spare ducts. Cap empty ducts with screw covers.

H. Label conduit at stub-up and manhole penetrations in accordance with Section 26 05 53.

3.3 PULL BOXES

A. All pull boxes shall be sized to accommodate all incoming and outgoing conduits.

B. Set pull boxes on 6” deep gravel or sand bed, flush with paving in paved areas, with paving sloping away from pull boxes. In unpaved areas locate boxes so that runoff water will not drain to pull box. Set cover 2” above finished grade and provide 6” thick by 12” wide concrete apron around box, sloping away from cover.

C. Caulk between all sections of pullboxes and coat exteriors with weatherproof compound.

END OF SECTION

This page is intentionally left blank.

SECTION 26 05 48 - VIBRATION AND SEISMIC CONTROLS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Furnish and install vibration control devices, materials, and related items. Perform all work as shown on the drawings and as specified herein to provide complete vibration isolation systems in proper working order.

1.2 MATERIAL AND EQUIPMENT

A. All vibration isolation mounts shall be supplied by one of the approved manufacturers stated in the PRODUCTS Section of this specification. Substitutions of equal equipment beyond the alternatives listed will be permitted only with the written permission of the Architect. Accompany each request for acceptance of substitute equipment with manufacturer's certified data proving the equivalence of the proposed substitute in quality and performance. The Architect shall be the final judge of the validity of the data submitted.

B. Unless otherwise specified, supply only new equipment, parts, and materials.

1.3 SUBMITTALS

A. Refer to related sections elsewhere for procedural instructions for submittals.

B. The shop drawing submittal for isolated electrical equipment shall include submittal information for the isolation mounts. Information supplied shall be as follows:

1. A complete description of products to be supplied including product data, dimensions, specifications, and installation instructions.
2. Detailed selection data for each vibration isolator supporting equipment, including:

    a. The equipment identification mark.
    b. The isolator type.
    c. The actual load.

C. Submission of samples may be requested for each type of vibration isolation device. After approval, samples will be returned for installation at the job. All costs associated with submission of samples shall be borne by the Contractor.

1.4 QUALITY ASSURANCE

A. Coordinate the size, location, and special requirements of vibration isolation equipment and systems with other trades. Coordinate plan dimensions with size of housekeeping pads.

B. Provide vibration isolators of the appropriate sizes and proper loading to meet the specified requirements.

C. Supply and install any incidental materials needed to meet the requirements stated herein, even if not expressly specified or shown on the drawings, without claim for additional payment.

D. Verify correctness of equipment model numbers and conformance of each component with manufacturer's specifications.

E. Should any electrical equipment cause excessive noise or vibration, the Contractor shall be responsible for remedial work required to reduce noise and vibration levels. Excessive is defined as exceeding the manufacturer's specifications for the unit in question.

F. Upon completion of the work, the Architect or Architect's representative shall inspect the installation and shall inform the installing contractor of any further work that must be completed. Make all adjustments as directed by the Architect that result from the final inspection. This work shall be done before vibration isolation systems are accepted.

PART 2 - PRODUCTS

2.1 VIBRATION ISOLATION MOUNT TYPES

A. Type DNP (Double Neoprene Pad):

1. Neoprene pad isolators shall be formed by two layers of ¼" to 5/16" thick ribbed or waffled neoprene, separated by a stainless-steel or aluminum plate. These layers shall be permanently adhered together. The pads shall be sized so that they will be loaded within the manufacturer's recommended range.
2. Type DNP isolators shall be formed from one of the following products or approved equal:

Type NR	Amber/Booth
Type Korpad	Korfund Dynamics
Type WSW	Mason Industries
Type NPS	Kinetics Noise Control
Series Shear Flex	Vibration Mountings & Control

B. Type HN (Hanger Neoprene):

1. Vibration isolation hangers shall consist of a neoprene-in-shear or glass fiber element contained in a steel housing. A neoprene neck bushing (or other element) shall be provided where the hanger rod passes through the hanger housing to prevent the rod from contacting the hanger housing. The diameter of the hole in the housing shall be sufficient to permit the hanger rod to swing through a 30° arc before contacting the hanger housing.
2. Type HN isolators shall be one of the following products or approved equal:

Type BRDA	Amber/Booth
Type H	Korfund Dynamics
Type HD	Mason Industries
Type RH or FH	Kinetics Noise Control
Type RHD or RFD	Vibration Mountings & Control

2.2 FLEXIBLE ELECTRICAL CONNECTIONS

A. Type A:

1. Flexible Electrical Connection Type A shall be a prefabricated unit incorporating a flexible and watertight outer jacket, grounding strap, plastic inner sleeve to maintain smooth wireway, and end hubs with tapered electrical threads to fit standard threaded rigid metal conduit.
2. Flexible Electrical Connection Type A shall be Crouse-Hinds (Syracuse, NY) "XD Expansion/Deflection Coupling," Spring City Electrical Mfg. Co. (Spring City, PA) "Type DF Expansion and Deflection Fitting," or approved equal.

B. Type B:

1. Flexible Electrical Connection Type B shall be field fabricated using a minimum 2 (two) foot length of flexible conduit or cable.

C. Type C:

1. Flexible Electrical Connection Type C shall be field fabricated using a minimum 4 (four) foot length of flexible conduit or cable.

PART 3 - EXECUTION

3.1 APPLICATION

A. Transformers, Unit Substations, and Uninterruptible Power Supplies (UPS):

1. Transformers, Unit Substations, and UPS devices within the building construction shall follow the following table:

Transformers	Base Type	Isolator Type	Static Defl (in.)	Mason Industries Type
Floor Mounted – Greater than 350 kVA	Rigid Steel	Spring	2	SLR or PC30N
Floor Mounted – 45 to 350 kVA	Trapeze	Neoprene	0.25	HD or ND
Suspended – 45 to 350 kVA	Trapeze	Spring	1	30N
Suspended – Less than 45 kVA		Neoprene	0.05	W

2. Electrical connections to isolated transformers and UPS devices shall be made using flexible electrical connections Type A or Type B.

B. Dimmers:

1. Dimmer cabinets shall be mounted on Type DNP isolators.
2. Electrical connections to dimmers shall be made using flexible electrical connections Type A or Type B.

C. Mechanical Equipment:

1. Electrical connections to vibration isolated mechanical equipment shall be made using flexible electrical connections Type A or Type C.

3.2 INSTALLATION

A. General:

1. In all cases, isolated electrical equipment shall be positioned so that it is free standing and does not come in rigid contact with the building structure or other systems.

B. Isolation Mounts:

1. All mounts shall be aligned squarely above or below mounting points for the supported equipment.
2. If a housekeeping pad is provided, the isolators shall bear on the housekeeping pad and the isolator base plate shall rest entirely on the pad.
3. Hanger rods for vibration isolated supports shall be connected to structural beams or joists, not to the floor slab between beams and joists. Provide suitable intermediate support members as necessary.
4. Vibration isolation hanger elements shall be positioned as high as possible in the hanger rod assembly, but not in contact with the building structure, and so that the hanger housing may rotate a full 360° about the rod axis without contacting any object.

C. Flexible Electrical Connections:

1. Type C connections shall be installed in a grossly slack “U” shape or a 360 loop.
2. Rigid conduit on the isolated-equipment side of the flexible connection, and the flexible connection itself, shall not be tied to the building construction or other rigid structures.

END OF SECTION

SECTION 26 05 53 - IDENTIFICATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

B. Requirements of the following Division 26 Sections apply to this Section:

1. “Electrical Requirements.”

1.2 SUMMARY

A. This Section includes identification of electrical materials, equipment, and installations. It includes requirements for electrical identification components including but not limited to the following:

1. Buried electrical line warnings.
2. Identification labeling for raceways, cables, and conductors.
3. Operational instruction signs.
4. Warning and caution signs.
5. Equipment labels and signs.

B. Related Sections: The following Sections contain requirements that relate to this Section;

1. Division 9 Section “Painting” for related identification requirements.
2. Division 26 Section “Electrical Power Conductors Cables” for requirements for color coding of conductors for phase identification.

C. Refer to other Division 26 Sections for additional specific electrical identification associated with specific items.

1.3 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.

B. Product Data for each type of product specified.

C. Schedule of identification nomenclature to be used for identification signs and labels.

D. Samples of engraved, plastic laminate to be used on switchgear, switchboards, disconnect switches and panelboards.

1.4 QUALITY ASSURANCE

A. Electrical Component Standard: Components and installation shall comply with NFPA 70 “National Electrical Code.”

B. ANSI Compliance: Comply with requirements of ANSI Standard A13.1, “Scheme for the identification of Piping Systems,” with regard to type and size of lettering for raceway and cable labels.

PART 2 - PRODUCTS

2.1 ELECTRICAL IDENTIFICATION PRODUCTS

A. Colored Adhesive Marking Tape for Raceways, Wires, and Cables: Self-adhesive vinyl tape not less than 3 mil thick by 1 inch to 2 inches in width.

B. Underground Line Marking Tape: Permanent, bright-colored, continuous-printed, plastic tape with magnetic tracer strip not less than 6-inches wide by 4-mil thick. Printed legend indicative of general type of underground line below.

C. Wire/Cable Designation Tape Markers: Vinyl or vinyl-cloth, self-adhesive, wrap around, cable/conductor markers with preprinted numbers and letters.

D. Engraved, Plastic-Laminated Labels, Signs, and Instruction Plates: Engraving stock melamine plastic laminate, 1/16-inch minimum thick for sign up to 20 square inches, or 8 inches in length; 1/8-inch thick for larger sizes. Engraved legend in black letters on white face for normal power and white letters on red face for emergency and standby power. Plastic laminate shall be punched for mechanical fasteners. Refer to details on drawings for exact information requirements.

E. Baked-Enamel Warning and Caution Signs for Interior Use: Preprinted aluminum signs, punched for fasteners, with colors, legend, and size appropriate to the location.

F. Exterior Metal-Backed Butyrate Warning and Caution Signs: Weather-resistant, non-fading, preprinted cellulose acetate butyrate signs with 20-gage, galvanized steel backing, with colors, legend, and size appropriate to the location. Provide ¼-inch grommets in corners for mounting.

G. Fasteners for Plastic-Laminated and Metal Signs: Self-tapping stainless-steel screws or number 10/32 stainless-steel machine screws with nuts and flat and lock washers.

H. Cable Ties: Fungus-inert, self-extinguishing, one-piece, self-locking nylon cable ties, 0.18-inch minimum width, 50-lb minimum tensile strength, and suitable for a temperature range from minus 50°F to 350°F. Provide ties in specified colors when used for color coding.

I. Electronic Labels: Self-adhesive, 3/16-inch-industrial label, black on clear for normal circuits and red on clear for emergency/standby circuits. Acceptable manufacturers include the following:

1. Brother
2. Kroy

PART 3 - EXECUTION

3.1 INSTALLATION

A. Lettering and Graphics: Coordinate names, abbreviations, colors, and other designations used in electrical identification work with corresponding designations specified or indicated. Install numbers, lettering, and colors as approved in submittals and as required by code.

B. Install identification devices in accordance with manufacturer's written instructions and requirements of NEC.

C. Sequence of Work: Where identification is to be applied to surfaces that require finish, install identification after completion of finish work.

3.2 IDENTIFICATION

A. Identify Junction, Pull, and Connection Boxes: Code-required caution sign for boxes shall be pressure-sensitive, self-adhesive label indicating system voltage in black, preprinted on orange background. Install on outside of box cover. Also, label box covers with identity of contained circuits. Use pressure-sensitive plastic labels at exposed locations and similar labels at concealed boxes.

B. Underground Electrical Line Identification: During trench backfilling, for underground power, signal, and communications lines, install continuous underground plastic line marker, located directly above line at 6 to 8 inches below finished grade. Where multiple lines installed in a common trench or concrete envelope do not exceed an overall width of 16 inches; install a single line marker.

C. Install line marker for underground wiring, both direct-buried and in raceway.

D. Identify Raceways of Certain Systems with Color Banding: Band exposed or accessible raceways of the following systems for identification. Bands shall be painted with colors indicated below. Make each color band 2 inches-wide, completely encircling conduit, and place adjacent bands of two-color markings in contact, side by side. Install bands at changes in direction, at penetrations of walls and floors, and at 40-foot maximum intervals in straight runs. Apply the following colors:

1. Fire Alarm Systems: Red.
2. Fire Suppression Supervisory and Control System: Red and Yellow.
3. Mechanical and Electrical Supervisory System: Green and Blue.
4. Telephone System: Green and Yellow.
5. Tag or label conductors as follows:

    a. Future Connections: Conductors indicated to be for future connection or connection under another contract with identification indicating source and intent.

b. Multiple Circuits: Where multiple branch circuits or control wiring or communications/signal conductors are present in the same box or enclosure label each conductor or cable. Provide label on each box indicating source, voltage, circuit number, and phase for branch circuit wiring. Phase and voltage of branch circuit wiring may be indicated by mean of coded color of conductor insulation. For control and communications/signal wiring, use color coding or wire/cable marking tape at terminations and at intermediate locations where conductors appear in wiring boxes, troughs, and control cabinets. Use consistent letter/number conductor designations throughout on wire/cable marking tapes.

c. Match identification markings with designations used in panelboards shop drawings, Contract Documents, and similar previously established identification schemes for the facilities' electrical installations.

E. Install labels at locations indicated and at locations for best convenience of viewing without interference with operation and maintenance of equipment.

F. Conductor Color Coding: Provide color coding for secondary service, feeder, and branch circuit conductors throughout the project secondary electrical system as follows:

208/120-Volts	Phase	480/277-Volts
Black	A	Brown
Red	B	Orange
Blue	C	Yellow
White	Neutral	Gray
Green	Ground	Green

G. Use conductors with color factory-applied the entire length of the conductors except as follows:

1. The following field-applied color-coding methods may be used in lieu of factory-coded wire for sizes larger than No. 10 AWG:

   a. Apply colored, pressure-sensitive plastic tap in half-lapped turns for a distance of 6 inches from terminal points and in boxes where splices or taps are made. Apply the last two laps of tape with no tension to prevent possible unwinding. Use 1-inch-wide tape in colors as specified. Do not obliterate cable identification markings by taping. Tape locations may be adjusted slightly to prevent such obliteration.

   b. In lieu of pressure-sensitive tape, colored cable ties may be used for color identification. Apply three ties of specified color to each wire at each terminal or splice point starting 3 inches from the terminal and spaced 3 inches apart. Apply with a special tool or pliers, tighten for snug fit, and cut off excess length.

2. All grounded conductors No. 6 AWG and smaller shall be a factory applied color across the entire length of conductors.

H. Power Circuit Identification:

1. Securely fasten wrap-around marker bands to cables, feeders, and power circuits in pull boxes, junction boxes, and switchgear rooms.

I. Apply warning, caution, and instruction signs and stencils as follows:

1. Install warning, caution, or instruction signs where required by NEC where indicated, or where reasonably required to assure safe operation and maintenance of electrical systems and of the items to which they connect. Install engraved plastic-laminated instruction signs with approved legend where instructions or explanations are needed for system or equipment operation. Install butyrate signs with metal backing for outdoor items.
2. Emergency Operating Signs: Install engraved laminate signs with white legend on red background with minimum 3/8-inch-high lettering for emergency instructions on power transfer, load shedding, or other emergency operations.
3. Arc Flash Labels: All electrical equipment shall be marked with a label consisting of the following information:

    a. Nominal voltage.
    b. Available fault current at the equipment.
    c. Clearing time.
    d. Arc flash hazard boundary.
    e. Flash hazard at 18”.
    f. PPE (Personnel protective equipment) level.
    g. Distance of limited approach.
    h. Distance of restricted approach.
    i. Distance of prohibited approach.
    j. Date label is applied or calculations were performed.

J. Install equipment/system circuit/device identification as follows:

1. Apply equipment identification labels of engraved plastic-laminate on each major unit for electrical equipment in the courts building including central or master unit of each electrical system. This includes communication/signal/alarm system, unless unit is specified with its own self-explanatory identification. Except as otherwise indicated, provide single line of text, with 3/8-inch-high lettering on 1-1/2-inch-high label (2-inch-high where two lines are required), black lettering in white field for normal power and red lettering on white field for emergency and standby power. Text shall match terminology and numbering of the Contract Documents and shop drawings. Apply labels for each unit of the following categories of electrical equipment:

    a. Panelboards, electrical cabinets, and enclosures.

        1) Labels shall include at a minimum: voltage, phase, ampacity, AIC rating, available fault current (and when it was calculated) and where the equipment is fed from. Refer to detail on drawings for additional information.

    b. Access doors and panels for concealed electrical items.
    c. Electrical switchgear and switchboards.

        1) Labels shall include at a minimum: voltage, phase, ampacity, AIC rating, available fault current and where the equipment is fed from. Refer to detail on drawings for additional information.

    d. Motor starters, motor control centers.
    e. Pushbutton stations.
    f. Power transfer equipment.
    g. Contactors.
    h. Remote-controlled switches.

i. Dimmers.
j. Control devices.
k. Transformers.

1) Include on label, location of primary overcurrent protection device.

l. Power generating units.
m. Telephone switching equipment.
n. Fire alarm master station or control panel.
o. Lighting control panel.
p. Static uninterruptable power supply

2. Apply electronic label on the inside of all receptacle and switch plates. The labels shall identify circuit and panelboard.
3. All emergency circuits shall be permanently marked as emergency as indicated below:

a. Junction Boxes – with permanently fastened labels.
b. Raceways – with permanently fastened labels at intervals of not more than 25ft.

K. Apply circuit/control/item designation labels of engraved plastic laminate for disconnect switches, breakers, pushbuttons, pilot lights, motor control centers, and similar items for power distribution and control components above, except panelboards and alarm/signal components, where labeling is specified elsewhere. For panelboards, provide framed, typed circuit schedules with explicit description and identification (including room numbers) of items controlled by each individual breaker.

L. Lighting control identification: A label shall be applied to the underside of the ceiling grid or access panel for lighting control boxes installed within plenums and above ceilings. The label shall include “LC”, manufacturer, and control zones of the box.

M. Fire Pump Service Identification: A placard shall be externally installed on the Fire Pump primary disconnecting means stating, “Fire Pump Disconnecting Mean.” The lettering shall be at least one inch in height. In addition, a placard shall be placed adjacent to the Fire Pump controller stating the location of this disconnecting means and the location of the key (if the disconnecting means is locked).

N. Electrical Service Room Distribution Placard: In each of the main electrical rooms, provide a single line riser diagram placard of the entire electrical distribution fed from that room. The placard shall also identify where other services are located per NEC 230.2(e). The riser diagram shall be framed under glass and mounted on the wall in the electrical room. The print shall be of diffusion transfer process to eliminate fading.

END OF SECTION

SECTION 26 05 73 – ELECTRICAL STUDIES

PART 1 - GENERAL

1.1 RELATED WORK SPECIFIED ELSEWHERE

A. Acceptance and startup testing requirements for electrical power distribution equipment and systems. Contractor shall retain and pay for the services of a recognized independent testing firm for purpose of performing inspections and tests as herein specified.

1. The testing firm shall provide all material, equipment, labor, and technical supervision to perform such tests and inspections.
2. It is the purpose of these tests to assure that all tested electrical equipment is operational and within industry and manufacturer's tolerances and is installed in accordance with design specifications.
3. The tests and inspections shall determine suitability for startup and energization.
4. The following equipment shall be tested and calibrated:
   Electrical Power Conductors and Cables – Section 26 05 19
   Grounding and Bonding – Section 26 05 26
   Low-Voltage Distribution Transformers – Section 26 22 13
   Distribution Switchboards – Section 26 24 13
   Panelboards – Section 26 24 16
   Diesel-Engine Driven Generator Set - Section 26 32 13
   Automatic Transfer Switch – Section 26 36 23

1.2 SUBMITTALS

A. Provide submittal per Contract General Conditions, Division 1, and Section 26 05 00.

B. Qualification of testing firm.

C. Submit one electronic copy of certified test reports to Engineer for approval.

D. One electronic copy of blank forms for checklists, test reports, and other related forms for Engineer's review and approval.

E. All studies, tests, and reports shall be sealed by a registered electrical professional engineer with a current Maryland stamp

1.3 GENERAL REQUIREMENTS

A. The Contractor shall perform routine insulation resistance, continuity, and rotation tests for all distribution and utilization equipment prior to and in addition to any acceptance testing.

B. The Contractor shall test all lighting, low-voltage relays and circuits to ensure proper operating conditions prior to acceptance testing.

C. The Contractor shall perform visual and mechanical inspections, verifying that the equipment nameplate information meets the intent of the drawings and specifications.

D. The Contractor shall be responsible for all final settings and adjustments on protective devices and tap changes, submitting settings to the Architect/Engineer for review.

E. Provide a complete short-circuit study, equipment interrupting/withstand evaluation, and a protective device coordination study for the electrical distribution system described herein. This study shall be submitted with electrical equipment submission and electrical room layouts.

F. The Contractor shall engage the services of a recognized corporate and financially independent testing firm for the purpose of performing inspections and tests as herein specified.

G. The firm shall provide all material, equipment, labor, and technical supervision to perform such tests and inspections.

H. It is the purpose of these tests to assure that all tested electrical equipment is operational and within industry and manufacturer's tolerances and is installed in accordance with design specifications.

I. The tests and inspections shall determine suitability for energization. Equipment shall not be energized until accepted by the testing firm.

1.4 QUALIFICATIONS OF TESTING FIRM

A. The testing firm shall be a recognized corporate and financially independent testing organization which can function as an unbiased testing authority, professionally independent of the manufacturers, suppliers, and installers of equipment or systems evaluated by the testing firm.

B. The testing firm shall be regularly engaged in the testing of electrical equipment devices, installations, and systems.

C. The testing firm shall meet OSHA criteria for accreditation of testing laboratories, Title 29, Part 1907, or be a Full Member company of the InterNational Electrical Testing Association (NETA).

D. The lead, on-site, technical person shall be currently certified by the InterNational Electrical Testing Association (NETA) or National Institute for Certification in Engineering Technologies (NICET) in electrical power distribution system testing.

E. The testing firm shall utilize engineers and technicians who are regularly employed by the firm for testing and engineering services.

F. The testing firm shall submit proof of the above qualifications with bid documents, when requested.

G. The terms used herewith, such as test agency, test contractor, testing laboratory, or contractor test company, shall be construed to mean the testing firm.

1.5 APPLICABLE CODES, STANDARDS, AND REFERENCES

A. All inspections and tests shall be in accordance with the following codes and standards except as provided otherwise herein:

1. National Electrical Manufacturer's Association - NEMA
2. American Society for Testing and Materials - ASTM

3. Institute of Electrical and Electronic Engineers - IEEE
4. InterNational Electrical Testing Association - NETA Acceptance Testing Specifications - ATS-2021
5. American National Standards Institute - ANSI C2: National Electrical Safety Code
6. State and City of Annapolis, Maryland Codes and Ordinances
7. Insulated Cable Engineers Association - ICEA
8. Association of Edison Illuminating Companies - AEIC
9. Occupational Safety and Health Administration - OSHA
10. National Fire Protection Association - NFPA

    a. ANSI/NFPA 70: National Electrical Code
    b. ANSI/NFPA 70B: Electrical Equipment Maintenance
    c. NFPA 70E: Electrical Safety Requirements for Employee Workplaces
    d. ANSI/NFPA 780: Lightning Protection Code
    e. ANSI/NFPA 101: Life Safety Code

B. All inspections and tests shall utilize the following references:

1. Project design specifications.
2. Project design drawings.
3. Short-circuit and coordination study.
4. Manufacturer’s instruction manuals applicable to each particular apparatus.
5. Project list of equipment to be inspected and tested as stated above.

PART 2 - SHORT-CIRCUIT, COORDINATION, AND ARC FLASH STUDIES

2.1 SHORT-CIRCUIT STUDY

The electrical equipment manufacturer shall perform a short-circuit analysis of the specified electrical power distribution system. This analysis shall include:

A. Calculation of the maximum RMS symmetrical three-phase short-circuit current available at significant locations in the electrical system. The results shall represent the highest short-circuit currents to which the equipment might be subjected under the reported system conditions. The short-circuit currents shall be calculated with the aid of a digital computer. Appropriate motor short-circuit contribution shall be included in the calculation.

B. The study shall include all portions of the electrical distribution system from the normal and alternate sources of power throughout the low-voltage distribution system. Normal system operating method, alternate operation, and operations which could result in maximum fault conditions shall be thoroughly covered in the study.

C. The study shall be calculated from the utility meter to the lowest overcurrent device or equipment on the electrical distribution system. The utility conductors shall not be used for calculations.

D. An evaluation of the adequacy of the short-circuit ratings of the electrical equipment supplied by that manufacturer.

E. Provide one electronic copy of the short-circuit analysis for the engineer’s approval.

F. A computer printout of input data, a computer printout of calculated results and an explanation of how to interpret the printouts.

G. A one-line diagram identifying all bus locations and the maximum available short-circuit current at each bus.

H. A bus-to-bus listing of the maximum available short-circuit current expressed in RMS symmetrical amperes and the X/R ratio of the fault current.

I. A table of equipment short-circuit ratings versus calculated short-circuit current values.

J. An analysis of the results in which any inadequacies shall be called to the attention of the Engineer and recommendations made for improvements. These recommendations shall be incorporated by the electrical equipment manufacturer to the electrical equipment at no cost to the Owner, where approved by the Engineer.

2.2 PROTECTIVE DEVICE COORDINATION STUDY

The electrical equipment manufacturer shall perform a protective device time-current coordination analysis of the entire electrical power distribution system. This analysis shall include:

A. A determination of settings or ratings for the over-current protective devices supplied. Where necessary, an appropriate compromise shall be made between system protection and service continuity with system protection and service continuity considered to be of equal importance. The time-current coordination analysis shall be performed with the aid of a digital computer.

B. An evaluation to the degree of system protection and service continuity possible with overcurrent devices supplied.

C. Provide one electronic copy of the protective device time-current coordination analysis for the Engineer’s approval.

D. Log-Log plots of time-current characteristic curves.

E. A tabulation of the suggested settings of the adjustable overcurrent protective devices supplied.

F. The key or limiting overcurrent device characteristics, load characteristics, and protection requirements affecting the setting or ratings of the overcurrent protective devices supplied.

G. The degree of service continuity and system protection achieved with the overcurrent protective devices supplied.

H. An analysis of the results in which any inadequacies shall be called to the attention of the Engineer and recommendations made for improvements. These recommendations shall be incorporated by the electrical equipment manufacturer to the electrical equipment at no cost to the Owner, where approved by the Engineer.

2.3 ARC FLASH HAZARD ANALYSIS

A. Provide with the coordination and short circuit studies an Arc Flash study and device by device listing of PPE requirements and ratings as required by the NEC and NFPA 70E. All equipment shall have appropriate labeling installed in the field by the electrical contractor as determined by the study.

B. The flash protection boundary and the incident energy shall be calculated at all significant locations in the electrical distribution system (switchgear, switchboards, panelboards, busway, etc.) where work could be performed on energized parts.

PART 3 - INSPECTION AND TEST PROCEDURES

3.1 PROCEDURE

A. Testing firm to provide and comply with the following:

1. Acceptance test procedures for each individual equipment listed in Part 1 of this section for Engineer review and approval prior to any test and after thorough evaluation of the system. Testing shall conform to the latest version of InterNational Electrical Testing Association (NETA) specifications and standards for electrical power distribution equipment and systems and manufacturer's instructions.
2. Refer to each individual specification section for testing requirements and comply.
3. Inspect installed equipment, record results and report any discrepancy and deficiency with contract documents and governing codes prior to testing. All results shall be submitted to the Engineer for approval.

3.2 SYSTEM FUNCTION TESTS

A. General:

1. Perform system function tests upon completion of equipment component tests as define in this specification. It is the purpose of system function tests to prove the proper interaction of all sensing, processing, and action devices.
2. Implementation:

   a. Develop test parameters for the purpose of evaluating performance of all integral components and their functioning as a complete unit within design requirements.
   b. Test all interlock devices, and trip settings on breakers.
   c. Record the operation of alarms and indicating devices.

3.3 DEFICIENCIES

A. All deficiencies reported by testing firm to be corrected by Contractor and Acceptance Test to be re-done accordingly.

END OF SECTION

This page is intentionally left blank.

SECTION 26 09 13 - ELECTRICAL POWER MONITORING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The requirements of the General Conditions, Supplementary Conditions and the following specification sections apply to all Work herein:

1. Section 26 05 00 - Electrical Requirements
2. Section 26 05 03 - Manufacturers
3. Section 26 05 19 - Electrical Power Conductors and Cables
4. Section 26 05 26 - Grounding and Bonding
5. Section 26 24 13 - Distribution Switchboards
6. Section 26 24 16 - Panelboards

1.2 SUMMARY

A. Furnish and install tenant sub-metering system as herein specified, as indicated on the Drawings and as required for the distribution of power throughout the building.

1.3 REFERENCE STANDARDS

A. Meters, metering enclosures, and all components shall be designed, manufactured and tested in accordance with the latest applicable industry standards including the following:

1. NFPA 70 - National Electrical Code (NEC)
2. ANSI C12.1 - Electric Meters Code for Electricity Metering
3. ANSI C12.20 - Electricity Meters 0.2 and 0.5 Accuracy Classes

B. All equipment and material to be furnished and installed on this Project shall be UL or ETL listed, in accordance with the requirements of the authorities having jurisdiction, and suitable for its intended use on this Project.

1.4 SUBMITTALS AND PROPOSALS

A. The following submittal data shall be furnished according to the General Conditions and Section 26 05 00 and shall include, but not be limited to:

1. Meters and metering enclosures complete with physical dimensions, schematic wiring diagram, product data, data maps, etc.
2. Product Data for all required network devices, conductors, computers, software, etc.
3. Network Topology Diagram including all devices, meters, building management computer interface location(s), wiring, meter addresses, all device physical locations, power requirements for all externally powered devices, etc.
4. Graphic Screen Shots required for computer software interface.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store meter equipment in clean dry space. Protect units from dirt, fumes, water, construction debris and traffic; where necessary to store outdoors, store electrical components above grade and enclose with watertight wrapping.

B. Handle meter equipment carefully to prevent internal components damage, breakage, denting, and scoring enclosure finish. Do not install damaged components; replace and return damaged units to equipment manufacturer.

1.6 QUALITY ASSURANCE

A. Manufacturer's Qualifications: The manufacturer of this equipment shall be regularly engaged in manufacture of submeter systems, of types, sizes, and ratings required and have produced similar electrical equipment, for a minimum period of five (5) years. When requested by the Engineer, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.

B. Warranty

1. Installation Warranty: A written warranty shall be supplied by the installing contractor agreeing to provide the labor and materials to replace any portion of the meter system equipment or wiring that fails due to materials or workmanship for a period of twelve months after substantial completion.
2. Manufacturer's Warranty: A written warranty shall be supplied by the manufacturer agreeing to replace any equipment that fails due to materials or workmanship for a period of 2 years.
3. Warranty Commencement: Warranty shall begin at the point of substantial completion of the system, which is defined as the date when commissioning and owner training has been completed and the Owner obtains beneficial use of the system.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. If it complies with these Specifications, switchboards manufactured one of the following will be acceptable:

1. E-Mon
2. Eaton/Cutler Hammer
3. Schneider/Square D
4. ABB/General Electric
5. Siemens
6. SmarteBuilding
7. QUADLOGIC

2.2 ELECTRIC SUBMETER

A. Each submeter shall meet ANSI C12.20 0.5% revenue accuracy class. The electronic meter shall accept inputs from industry standard instrument transformers. The current and voltage signals shall be digitally sampled to provide accurate RMS sensing.

B. Each meter shall be powered via line voltage. Provide Control Power Transformer where required to power meter.

C. The power meter shall be 3-phase, 4-wire, and accept either 480/277V or 208/120V metering inputs.

D. Where multiple meters of the same voltage source are grouped, a single enclosure housing the quantity of grouped 3-phase meters shall be utilized as indicated on the drawings.

E. At the Electrical Subcontractors option; in lieu of installing multiple 3-phase meters, provide individual meter with a minimum of five (5) sets of 3-phase current sensor inputs for the equivalent of five (5) separate 3-phase meters. Meter shall comply with all specification requirements listed herein.

F. All setup parameters and metered readings shall be available from a meter mounted alphanumeric display or adjustable through software interface.

G. The electronic meter shall provide, at a minimum, the following readings at its display and through the digital interface port specified hereinafter:

1. RMS current per phase.
2. RMS voltage phase-to-phase and phase-to-neutral.
3. Real Time KW three phase total.
4. Real Time kVAR three phase total.
5. Real Time kVA three phase total.
6. kW Peak demand.
7. kVAR Peak demand.
8. kVA Peak demand.
9. Power factor average.
10. kWH.
11. kVARH.
12. kVAH.

H. Demand reading intervals shall be adjustable from 5 to 60 minutes, set to 15 minutes, in steps of 1 minute.

I. Each meter or meter enclosure as described herein shall be provided with BACnet MS/TP protocol interface for meter communication to remote monitoring.

2.3 ELECTRICAL SUBMETER ENCLOSURE

A. Meter enclosures shall be formed from Code gauge steel with door that is hinged with master keyed flush door locks or with bolted enclosure cover and shall be UL 50 listed and labeled.

B. The indoor enclosure shall meet the requirements of UL 50 for NEMA 1 type construction.

C. Each meter enclosure shall be identified by laminated plastic nameplates indicating meter enclosure designation and voltage. Each meter within the enclosure shall be individually identified and labeled. See Section 26 05 53 for identification requirements.

D. The voltage source for the meter enclosure shall be provided with external 3-pole, 20 amp circuit breaker or 3-pole, 20 amp fused disconnect furnished by the Electrical Contractor. The disconnecting means shall be integral to the switchboard or panelboard being metered.

E. Where multiple meters in a single enclosure are provided, comply with the following:

1. Space shall be provided for future meters where meters are not installed initially. Where enclosure is provided with front mounted display, all unused meter spaces shall have blank off plates installed.
2. There shall be a single main terminal block for voltage inputs. Each enclosure shall only receive voltage from a single source. Each space shall be prepared with pre-wired terminal block for voltage from the main voltage inputs to the enclosure.
3. A control power transformer shall be provided within the meter enclosure with primary and secondary fusing where required for 120 volt power.
4. Shorting terminal blocks shall be provided for all direct sensing unprotected current sensors for each meter and each meter space. Current sensors with voltage rise above 50 volts if leads are open-circuited shall be considered unprotected.
5. Each meter enclosure as described herein shall be provided with a digital open protocol interface for meter communication to remote monitoring.

2.4 CURRENT AND VOLTAGE SENSING

A. Provide and install current sensors where indicated on the drawings. Current sensors shall be split core to enable installation around existing conductors. Current sensors shall be provided by the meter manufacturer.

B. Where required by the meter manufacturer, provide and install voltage transformers. Voltage transformers shall be provided by the meter manufacturer, be located within the meter enclosure and shall have primary fusing.

C. Current and voltage transformers in combination with the tenant meter shall provide specified revenue accuracy.

D. Provide, install, and terminate all current and voltage sensing conductors from the sensor or source location to the meter enclosure.

2.5 ELECTRICAL POWER MONITORING SYSTEM (EPMS)

A. Provide a complete integrated EPMS turnkey installation as detailed in this specification and as indicated in the drawings. The EPMS shall be configured to ensure reliability of systems operation. The EPMS topology may vary as long as it meets the intent and performance required of these specifications.

B. In addition to tenant submetering, the EPMS shall monitor all power meters specified in other sections of the Division 26 specifications including but not limited to Section 26 24 13 - Switchboards - 600 Volts.

C. The EPMS shall be provided with server workstation located in the Level 1 Server Room.

D. Provide and install network for all sub-metering communications from each meter enclosure location to a single point within the building. The sub-metering network shall be Modbus RTU or BACnet MS/TP and shall be independent of all other networks within the building (Alternate to provide Modbus TCP/IP sub-metering network in lieu of Modbus RTU or BACnet MS/TP). All hubs, conduits, sleeves, power supplies, circuiting, switches, network cabling and other facilities shall be provided as required for a complete and operable system.

E. The EPMS shall communicate to all sub-metering as well as each main meter and other building electrical infrastructure metering specified within Division 26. Refer to Specification Section 26 24 13 - Switchboards for additional information. Install protocol converters and networking as required.

F. The EPMS shall be provided with a digital Modbus TCP/IP open protocol interface port for connection to the BMS (wiring by the BMS Subcontractor). Provide all electronics and protocol converters required to communicate Modbus TCP/IP. Coordinate requirements with Division 23.

G. The meter manufacturer shall provide a web-based tenant metering application that will allow user to download, store, view, and provide tenant bills at predefined intervals. Provide a “Billing Application” to create tenant bills. Meter and billing data for each tenant shall be accessible using the tenant’s unique identification and password. Meter and billing data shall be accessible via web-based viewing and be available in Microsoft Excel.

H. The following additional features of the application described in paragraph G. above shall be available:

1. Input of other utilities such as water, air, gas and steam shall be allowed.
2. Detailed trend plots (Consumption Tracker) with a time period selectable by the end user by hour, day, month or yearly basis.
3. Energy usage bar charts by meter or groups of meters.
4. Detailed consumption reports with meter profile information.

I. The Billing Application shall use easy to use wizards that will allow the user to set:

1. Multiple rates
2. Taxes
3. Administration charges
4. Setup charges
5. Late payment dates
6. Late payment charges
7. Custom charges
8. Customer names and id numbers.
9. Reports shall include the Customers name, location, period covered, move in & out dates, payment type and invoice number.

J. Provide computing and memory hardware and software required for remote monitoring including all programming. Provide all software licensing, support, and material for maintenance and service of all required computing and memory hardware and software for a minimum period of five (5) years.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Metering shall be installed per the manufacturer’s recommendations and as indicated on the Drawings.

B. Communication cabling for communications to BMS from the EPMS shall be provided as part of the Division 23 Scope of Work. Coordinate communication wiring port requirements with the BMS Subcontractor.

C. The Contractor shall furnish, install and terminate all voltage and sensor conductors and associated conduits external to any factory supplied equipment.

D. Where meter enclosures are mounted on gypsum board partitions, the mounting screws shall pass through the gypsum board and be securely attached to the partition studs or framework. At the Subcontractor’s option, the mounting screws may pass through the gypsum board and be securely attached to 6" square, 18 gauge galvanized metal backplates, which are attached to the gypsum board with an approved nonflammable adhesive. Toggle bolts installed in gypsum board partitions will not be acceptable.

3.2 FACTORY TESTING

A. All standard factory tests shall be performed in accordance with the latest version of NEMA and UL Standards.

3.3 FIELD TESTING

A. System manufacturer's local representative shall provide startup assistance including:

1. Coordination and direction as necessary for the installation, hookup, interface and operation of the meter system.
2. All required programming and configuration necessary to program each meter and to allow communications via the communication interface to the EPMS.
3. Three (3) four (4) hour onsite training seminars and hands on training for the Owner's representative and building engineer covering all installation, operation and programming of system functions.

END OF SECTION

SECTION 26 09 36 – MODULAR DIMMING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Modular dimming control systems.

B. Related Sections:

1. Section 26 05 19 – Electrical Power Conductors and Cables
2. Section 26 09 13 - Electrical Power Monitoring
3. Section 26 24 13 – Distribution Switchboards
4. Section 26 24 16 – Panelboards
5. Section 26 27 26 - Wiring Devices
6. Section 26 51 00 – Lighting Fixtures

1.2 REFERENCES

A. American National Standards Institute/Institute of Electrical and Electronic Engineers (ANSI/IEEE) (www.ansi.org)

1. C62.41-1991 – Recommended Practice for Surge Voltages in Low-Voltage AC Power Circuits.

B. ASTM International (ASTM) (www.astm.org)

1. D4674 -02a Standard Test Method for Accelerated Testing for Color Stability of Plastics Exposed to Indoor Fluorescent Lighting and Window-Filtered Daylight.

C. Canadian Standards Association (CSA) (www.csa.ca)

1. CSA C22.2 # 14 Industrial Control Equipment
2. CSA C22.2 # 184 Solid-State Lighting Controls
3. CSA C22.2 # 156 Solid-State Speed Controls

D. International Electrotechnical Commission (www.iec.ch)

1. (IEC) 801-2 Electrostatic Discharge Testing Standard.
2. IEC/EN 60669-2-1 Switches for household and similar fixed electrical installations - electronic switches.

E. International Organization for Standardization (ISO)

1. 9001:2000 – Quality Management Systems.

F. National Electrical Manufacturers Association (NEMA)

1. WD1 (R2005) - General Color Requirements for Wiring Devices.

G. Underwriters Laboratories, Inc. (UL) (www.ul.com):

1. UL 489 is the UL Standard for Safety for Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures that Underwriters Laboratories uses to independently evaluate, test and List circuit breakers for use on lighting and other branch circuits in compliance with the NEC code. It is important that circuit breakers used for branch circuit over current protection are UL 489 listed to ensure that all NEC code requirements are met.
2. 489 (2002) - Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures.
3. UL 508 is the UL Standard for Safety for Industrial Control Equipment that Underwriters Laboratories uses to independently evaluate, test and List dimmer panels. The limited short circuit test required by this standard tests that the product fails safely in the event that the output terminals to the load are short-circuited. This is an important safety test.
4. 508 (1999) - Standard for Industrial Control Equipment.
5. UL 1472 is the Underwriters Laboratories Standard for Safety of Solid State Dimming Controls that sets limits on the amount of DC voltage a dimmer may deliver to a magnetic ballast or transformer. UL Listed wall box dimmers must comply with this standard. This ensures that the dimmer will not overheat the transformer.
6. Lutron applies this requirement in the design and testing of all the Commercial system dimming products for MLV loads as well.
7. 1472 (1996) - Solid-State Dimming Controls.
8. UL 924 is the UL Standard for Safety for Emergency Lighting and Power Equipment ensures that the lighting system will meet safety requirements in emergency situations.
9. 924 (2003) - Emergency Lighting and Power Equipment

1.3 SYSTEM DESCRIPTION

A. Provide, install, and test the modular architectural lighting control system as specified herein for the areas indicated on the drawings, specifications and load schedule(s). Self-contained preset lighting controls shall be provided in the following locations:

1. Site
2. Façade
3. Terraces
4. Atrium
5. Elevator Lobbies
6. Monumental Stair
7. Lobby
8. Screening Areas
9. Courtrooms
10. Conference Rooms
11. Judge and Justice Chambers
12. Library
13. Workrooms
14. Breakrooms
15. Reception Areas
16. Circulation

17. Wellness Center
18. Garage Entrance Drives
19. Staff Offices
20. Visiting Judge Chambers

B. System includes:

1. Processors and Gateways
2. Distributed Load Control panels
3. Computer software and lighting management apps
4. Wall mounted touch screen control panel with preset scenes and integrated astronomic timeclock
5. Wall mounted low voltage 5-scene wall stations with raise/lower capability within each scene
6. Wall mounted low voltage 3-scene wall stations with raise/lower capability within each scene
7. Ceiling mounted occupancy and daylight sensors, as required and specified by Electrical Engineer
8. RS232 interface for communication with the A/V system in each Conference Room, Training Room, Courtroom, Judge's Chamber, and Workroom.
9. Power interfaces and control modules
10. Low Voltage Controlled Dimmable LED Drivers
11. DALI-2 digital dimming drivers
12. Emergency lighting control when used with UL 924 devices, as required and specified by Electrical Engineer
13. Room-combining partition sensors and required interfaces

1.4 SUBMITTALS

A. Submit under provisions of Section 01 3000.
B. Specification Conformance Document: Provide written review of specification. Dimming Equipment Manufacturer shall:

1. Indicate whether the submitted equipment meets specification exactly as stated.
2. Indicate whether the submitted equipment meets specification via an alternate means and indicate the specific methodology used.
3. Be deemed to have included all equipment which is by implication necessary for the complete and satisfactory operation of the dimming systems. Any errors, omissions or ambiguities shall be brought to the attention of the Project Manager, Electrical Consultant, or Lighting Consultant in their possible effect on the intent of this specification.
4. Be responsible for indicating in writing at the time of submission of his bid any changes or deviations to the electrical, mechanical, or architectural installation, or any other aspect of the building design, which may be required to accommodate his particular equipment and its installation.

C. Submittals; include:

1. Bill of Materials
2. Sequence of Operation to describe how each area operates
3. Load schedule

a. Indicate actual connected load, load type, voltage per circuit, all circuits and their respective control zones, and all circuits that are on emergency.
b. Include capacity, phase, and corresponding circuit numbers.
c. Provide all interfaces and additional control modules as required for fully functioning compatible control of installed dimming system.

1) Summary of Control Intent per Space Type

d. Complete schematic (one-line diagram) of system. One-line diagram shall include the quantity of dimmer racks required for each area or series of areas, the power supply required for each rack or series of racks, and the size and type of control wiring required between the dimmer racks and the control panels, scene selectors, or other control devices.
e. Equipment Layout Sheets showing locations of control stations and modules as required on architectural plan background.
f. Sample of manufacturer's warranty (see following section 1.8).

D. Product Data: Catalog cut sheets with performance specifications including historical testing data demonstrating compliance with specified requirements.

1. Include ratings, configurations, standard wiring diagrams, dimensions, colors, service condition requirements, and installed features.
2. For occupancy/vacancy sensors, include detailed basic motion detection coverage range diagrams.
3. Manufacturer's Installation Instructions: Include application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

E. Shop Drawings:

1. Provide schematic system riser diagram indicating component interconnections. Include requirements for interface with other systems.
2. Provide detailed sequence of operations describing system functions.

F. Samples:

1. Wall Controls:

a. Show available color and finish selections.
b. Provide sample(s) for each product upon request.

2. Sensors:

a. Provide sample(s) for each product upon request.

G. Manufacturer's Installation Instructions:

1. Include application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

H. Approvals: Deviation from this specification must be documented in writing to the Lighting Designer, Architect and Electrical Engineer at least ten business days in advance to bid date. Complete catalogue data, specifications and technical information on alternate equipment must be provided including all associated cost savings or additions, including but not limited to equipment, programming, documentation and project management.
I. System Performance-Verification Documentation**.** Include as part of the base bid additional costs for manufacturer's enhanced documentation detailing start-up performance-verification procedures and functional tests performed along with test results.
J. Project Record Documents: Record actual installed locations and settings for lighting control system components.
K. Operation and Maintenance Data: Include detailed information on lighting control system operation, equipment programming and setup, replacement parts, and recommended maintenance procedures and intervals.
L. Warranty: Submit sample of manufacturer's Warranty or Enhanced Warranty as specified in Part 1 under "WARRANTY". Submit documentation of final execution completed in Owner's name and registered with manufacturer.

1.5 CLOSEOUT SUBMITTALS

A. Operating and maintenance instructions
B. Sustainable Design Closeout Documentation

1. Lighting Control System Manufacturer to provide LEED commissioning documentation that details the start-up procedure being performed including a process to follow, details on tests performed and an area that documents any test results.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualification:

1. Manufacturer of architectural lighting controls with minimum [10] years record of satisfactory manufacturing and support of components.
2. Manufacturer’s Quality System: Registered to ISO 9001:2000 Quality Standard, including in-house engineering for product design activities.
3. Qualified to supply specified products and to honor claims against product presented in accordance with warranty.

B. Source Requirements: Provide modular dimming controls hardware and software through a single source from a single manufacturer.
C. Electrical components, devices, and accessories: UL listed and labeled.
D. Maintain at project site a copy of each referenced document that prescribes execution requirements.
E. Maintenance Contractor Qualifications: Manufacturer's authorized service representative.

1.7 PROJECT CONDITIONS

A. Do not install equipment until following conditions can be maintained in spaces to receive equipment:

1. Ambient temperature: 0 degrees to 40 degrees C (32 degrees to 104 degrees F).
2. Relative humidity: Maximum 90 percent, non-condensing.
3. Lighting control system must be protected from dust during installation.

B. Store products in clean, dry space in original manufacturer's packaging in accordance with manufacturer's written instructions until ready for installation.

1.8 WARRANTY

A. Manufacturer's Standard Warranty, **With** Manufacturer Start-Up:

1. Manufacturer Lighting Control System Components, Except Ballasts/Drivers and Ballast Modules:

a. First two years:

1) One year 100 percent parts coverage, 100 percent manufacturer labor coverage to troubleshoot and diagnose a lighting issue.
2) First-available on-site or remote response time
3) Remote diagnostics for applicable systems.
4) Telephone Technical Support: Available 24 hours per day, 7 days per week, excluding manufacturer holidays.

B. Ballasts/Drivers and Ballast Modules: Three years, 100 percent parts coverage, no manufacturer labor coverage.

C. Include as part of the base bid additional costs for manufacturer's Enhanced Warranty with manufacturer Start-up*;* coverage to include items listed under manufacturer's standard warranty with manufacturer start-up above, **plus** the following upgrades:

1. Manufacturer Lighting Control System Components, Except Lighting Management System Computer, Ballasts/Drivers and Ballast Modules:

a. First Two Years: Upgrade from as-available Field Service response to **24-hour on-site or remote response time**.
b. Plus annual scheduled Preventive Maintenance Visit.
c. Additional Coverage for Years 3-5: 50 percent replacement parts coverage, no manufacturer labor coverage.
d. Additional Coverage for Years 6-8: 25 percent replacement parts coverage, no manufacturer labor coverage.

1.9 MAINTENANCE

A. Make ordering of new equipment for expansions, replacements, and spare parts available to end user.

B. Make new replacement parts available for minimum of ten years from date of manufacture.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis of Design Manufacturer: Lutron Electronics Co., Inc. – System: Athena
B. Acceptable Alternate Manufacturers:

1. Crestron Electronics, Inc – System: Zum
2. ETC. – System: Unison
3. Products by listed manufacturers are subject to compliance with specified requirements.

C. Substitutions: Permitted under provisions of Division 1
1. All proposed substitutions (clearly delineated as such) must be submitted in writing for approval by the design professional a minimum of 10 working days prior to the bid date and must be made available to all bidders. At a minimum the following must be included:
2. Product data indicating compliance with requirements of this section
3. Samples of each component
4. Sample submittals from similar project
5. Project references: Minimum of 25 completed installations, with Owner and Architect contact information
6. Sample warranty
7. Proposed substitutes must be accompanied by a review of the specification noting compliance on a line-by-line basis.
8. By using pre-approved substitutions, the contractor accepts responsibility and associated costs for all required modifications to circuitry, devices, and wiring.
9. Provide complete engineered shop drawings (including power wiring) with deviations for the original design highlighted in an alternate color to the engineer for review and approval prior to rough-in.
10. A comprehensive list of any deviations from required features for control equipment noted in this specification, or if any control equipment has additional features not noted this must be stated at the time of the bid so that the system can be fully appraised.

2.2 GENERAL REQUIREMENTS

A. Provide system hardware that is designed, tested, manufactured, and warranted by a single manufacturer.
B. Architectural Lighting Controls: Ten-year operational life while operating continually at any temperature in an ambient temperature range of 0 degrees C (32 degrees F) to 40 degrees C (104 degrees F) and 90 percent non-condensing relative humidity.
C. All equipment shall be designed and tested to withstand electrostatic discharges up to 15,000 V without impairmentper IEC 801-2.
D. As part of bid provide statement giving length of time required from the time of order to the time of delivery to the site. Note any special fast track items available to shorten delivery time and include cost of such service.
E. Unless specifically indicated to be excluded, provide all required equipment, conduit, boxes, wiring, connectors, hardware, supports, accessories, software, system programming, etc. as necessary for a complete operating system that provides the control intent indicated.

2.3 INSTALLATION

A. Sensor layout and coordination:

1. Coordinate placement of sensors and wall controls with millwork, furniture, equipment, etc. under other sections or by others.
2. Coordinate the placement of wall controls with actual installed door swings.
3. Coordinate the placement of daylight sensors with windows, skylights, and luminaires to achieve optimum operation. Coordinate placement with ductwork, piping, equipment, or other potential obstructions to light level measurement installed under other sections or by others.
4. Where motorized window treatments are to be controlled by the lighting control system provided under this section, coordinate the work with other trades to provide compatible products.
5. Contractor to confirm dimming compatibility of power supplies, transformers, and ballasts for all luminaires and lamps to be controlled by provided dimming system.
6. Notify Architect and Electrical Engineer of any conflicts or deviations from the contract documents to obtain direction prior to proceeding with work.

B. Pre-Installation Meeting: Conduct on-site meeting with lighting control system manufacturer prior to commencing work as part of manufacturer’s standard startup services. Manufacturer to review the following with installer:

1. Low voltage wiring requirements Low voltage wiring requirements.
2. Separation of power and low voltage/data wiring.
3. Wire labeling.
4. Lighting management hub locations and installation.
5. Where Lighting Control Manufacturer Sensor Layout and Tuning service is specified in Part 2 under "DIGITAL-NETWORK LIGHTING CONTROL SYSTEM - GENERAL REQUIREMENTS", sensor locations to be reviewed in accordance with layout provided by Lighting Control Manufacturer. Lighting Control Manufacturer may direct Contractor regarding sensor relocation should conditions require deviation from locations indicated.
6. Control locations.
7. Computer jack locations.
8. Load circuit wiring.
9. Network wiring requirements.
10. Connections to other equipment and other controls equipment.
11. Installer responsibilities.
12. Power panel locations.

C. Sequencing:

1. Do not install sensors and wall controls until final surface finishes and painting are complete.

2.4 DIMMING PERFORMANCE REQUIREMENTS

A. Provide products listed, classified, and labeled by Underwriter's Laboratories Inc. as suitable for purpose indicated.
B. Unless specifically indicated to be excluded, provide required equipment, conduit, boxes, wiring, connectors, hardware, supports, accessories, software, system programming, etc. as necessary for complete operating system that provides control intent indicated.

C. Design lighting control equipment for 10-year operational life while operating continually at any temperature in ambient temperature range of 32 degrees F (0 degrees C) to 104 degrees F (40 degrees C) and 90 percent non-condensing relative humidity.
D. Electrostatic Discharge Tolerance: Design and test equipment to withstand electrostatic discharges without impairment when tested according to IEC 61000-4-2.
E. Dimming and Switching/Relay Equipment:

1. Designed so that electrolytic capacitors operate at least 36 degrees F (20 degrees C) below capacitor's maximum temperature rating when device is under fully loaded conditions at maximum rated temperature.
2. Inrush Tolerance:

    a. Utilize load-handling thyristors (SCRs and triacs), field effect transistors (FETs) and isolated gate bipolar transistors (IGBTs) with maximum current rating at least two times rated operating current of dimmer/relay.
    b. Capable of withstanding repetitive inrush current of 50 times operating current without impacting lifetime of dimmer/relay.

3. Surge Tolerance: Designed and tested to withstand surges of 6,000 V, 200 amps according to IEEE C62.41.2 without impairment to performance.
4. Power Failure Recovery: When power is interrupted and subsequently restored, within 3 seconds lights to automatically return to same levels, e.g. dimmed setting, full on, or full off, as prior to power interruption.
5. Dimming Requirements:

    a. Line Noise Tolerance: Provide real-time cycle-by-cycle compensation for incoming line voltage variations including changes in RMS voltage (plus or minus 2 percent change in RMS voltage per cycle), frequency shifts (plus or minus 2 Hz change in frequency per second), dynamic harmonics, and line noise.

        1) Systems not providing integral cycle-by-cycle compensation to include external power conditioning equipment as part of dimming system.

    b. Incorporate electronic "soft-start" default at initial turn-on that smoothly ramps lights up to appropriate levels within 0.5 seconds.
    c. Utilize air gap off to disconnect load from line supply.
    d. Control light sources in smooth and continuous manner. Dimmers with visible steps are not acceptable.
    e. Load Types:

        1) Assign load type to each dimmer that will provide proper dimming curve for specific light source to be controlled.
        2) Provide capability of being field-configured to have load types assigned per circuit.

    f. Minimum and Maximum Light Levels: User adjustable on circuit-by-circuit basis.

    g. Line Voltage Dimmers; Meet following load-specific requirements:

        1) Dimmer for magnetic Low Voltage (MLV) transformer(s):

a) Contain circuitry designed to control and provide a symmetrical AC waveform to input of magnetic low voltage transformers per UL 1472, Section 5.11.
b) Dimmers using unipolar load current devices (such as FETs or SCRs) shall include DC current protection in the event of a fail open to prevent DC power from flowing into magnetic low voltage load.

2) Dimmer for electronic Low Voltage (ELV) transformer(s):Electronic transformers are susceptible to damage and audible noise issues if used with improper dimming wave forms. Most electronic transformers require a reverse phase control wave form. Transformer manufacturers should be able to provide detailed information on dimming requirements.

6. Low Voltage Dimming Modules; Meet following requirements:

a. Coordination between low voltage dimming module and line voltage relay: Capable of being electronically linked to single zone.

7. Single low voltage dimming module; capable of controlling following light sources:

a. 0-10V analog voltage signal.

1) Provide Class 2 isolated 0-10V output signal conforming to IEC 60929.
2) Sink current via IEC 60929.
3) Source current

b. 10-0V reverse analog voltage signal
c. DSI digital communication
d. DALI broadcast communication per IEC 60929:

1) Logarithmic intensity values complying with IEC 60929
2) Linear intensity values for use with LED color intensity control

e. PWM per IEC 60929.

F. Switching Requirements:

1. Rated Life of Relays: Typical of 1,000,000 cycles at fully rated 16 A for all lighting loads.
2. Switch load in a manner that prevents arcing at mechanical contacts when power is applied to and removed from load circuits.
3. Provide output fully rated for continuous duty for inductive, capacitive, and resistive loads.

G. Non-dim circuits to meet the following requirements:

1. Rated life of relay at full load: Minimum 1,000,000 cycles.
2. Load switched in manner that prevents arcing at mechanical contacts when power is applied to and removed from load circuits.
3. Fully rated output continuous duty for inductive, capacitive, and resistive loads.

H. Device finishes:

1. Wall Control finish shall be selected by Architect and confirmed in shop drawing review process.

    a. Standard colors: Comply with NEMA WD1 where applicable.
    b. Color variation in same Product Family: Maximum delta E of 1, CIE L*a*b color units.

2. Visible Parts: Exhibit ultraviolet color stability when tested with multiple actinic light sources as defined in ASTM D4674. Provide proof of testing upon request.

I. Interface with building automation system as specified by Electrical Engineer. Include system and network integrator visit.

2.5 LED DRIVERS

A. General Requirements:

1. Operate for at least 50,000 hours at maximum case temperature and 90 percent noncondensing relative humidity.
2. Provide thermal protection by automatically reducing power output to protect LED driver and LED light engine/fixture from damage due to over-temperature conditions that exceed the LED driver's maximum operating temperature at calibration point (tc).
3. Provide integral recording of operating hours and maximum operating temperature to aid in troubleshooting and warranty claims.
4. Designed and tested to withstand electrostatic discharges without impairment when tested according to IEC 61000-4-2.
5. Manufactured in facility that employs ESD reduction practices in compliance with ANSI/ESD S20.20.
6. UL 8750 recognized or listed as applicable.
7. UL Type TL rated or UL Class P listed where possible to allow for easier fixture evaluation and listing of different driver series.
8. Suitable for field replacement as applicable; listed in accordance with UL 1598C or UL 8750, Class P as indicated.
9. Designed and tested to withstand Category A surges of 4,000 V according to IEEE C62.41.2 without impairment of performance.
10. Class A sound rating; Inaudible in 27 dBA ambient.
11. Demonstrate no visible change in light output with variation of plus or minus 10 percent change in line-voltage input.
12. LED drivers of same family/series to track evenly across multiple fixtures at all light levels.
13. Offer programmable output currents in 10 mA or smaller increments within designed driver operating ranges for custom fixture length and lumen output configurations, while meeting low-end dimming range of 100 to 0.1 percent, 100 to 1 percent or 100 to 5 percent as applicable.
14. Meet NEMA 410 inrush requirements for mitigating inrush currents with solid state lighting sources.
15. Employ integral fault protection up to 277 V to prevent LED driver damage or failure in event of incorrect application of line-voltage to communication link inputs.
16. LED driver may be remote located up to 100 feet (30 m) from LED light engine depending on power outputs required and wire gauge utilized by installer.

B. 3-Wire Control:

1. Provide integral fault protection to prevent driver failure in event of miswire.

2. Operate from input voltage of 120 V through 277 V at 50/60 Hz.

C. Digital Control:

1. Employ power failure memory; LED driver to automatically return to previous state/light level upon restoration of utility power.
2. Operate from input voltage of 120 V through 277 V at 50/60 Hz.
3. Automatically go to 100 percent light output upon loss of control link voltage and lock out system commands until digital control link voltage is restored. Manufacturer to offer UL 924 compliance achievable through use of external interface upon request.
4. Responds to digital load shed command, i.e. if light output is at 30 percent and load shed command of 10 percent is received, ballast automatically sets maximum light output at 90 percent and lowers current light output by three percent to 27 percent.
5. Digital low-voltage control wiring capable of being wired as either Class 1 or Class 2.

D. Products:

1. Digital Control, 0.1 Percent Dimming with Soft-On and Fade-to-Black Low End Performance:

    a. Dimming Range: 100 to 0.1 percent measured output current.
    b. Features smooth fade-to-on and fade-to-black low end dimming performance for incandescent-like dimming experience.
    c. Typically dissipates 0.25 W standby power at 120 V and 0.40 W standby power at 277 V.
    d. Complies with FCC requirements of CFR, Title 47, Part 15, for commercial applications at 120-277 V and residential applications at 120 V.
    e. Total Harmonic Distortion (THD): Less than 20 percent at maximum power; complies with ANSI C82.11.
    f. Class 2 output designed to withstand hot swap of LED loads; meets UL 1310 and CSA C22.2 No. 223.
    g. Driver outputs to be short-circuit protected, open-circuit protected, and overload protected.
    h. Constant Voltage Drivers:

        1) Support for cove and under-cabinet fixtures at 24 V.

            a) Support LED arrays from 2 W to 96 W.
            b) Pulse Width Modulation (PWM) dimming frequency meets IEEE 1789.
            c) Meets solid state requirements for power factor, transient protection, standby power consumption, start time, and operating frequency in Energy Star for Luminaires Version 2.0.
            d) UL listed.

2. 3-Wire Control, 0.1 Percent Dimming:

    a. Dimming Range: 100 to 0.1 percent measured output current.
    b. Complies with FCC requirements of CFR, Title 47, Part 15, for commercial applications at 120-277 V and residential applications at 120 V.
    c. Total Harmonic Distortion (THD): Less than 20 percent at maximum power; complies with ANSI C82.11.
    d. UL Class 2 output designed to withstand hot swap of LED loads.

e. Driver outputs to be short-circuit protected, open-circuit protected, and overload protected.
f. Constant Voltage Drivers:

1) Support for cove and under-cabinet fixtures at 24 V.

a) Support LED arrays from 2 W to 96 W.
b) Pulse Width Modulation (PWM) dimming frequency meets IEEE 1789.
c) Meets solid state requirements for power factor, transient protection, standby power consumption, start time, and operating frequency in Energy Star for Luminaires Version 2.0.
d) UL listed.

3. Digital Control, 0.1 Percent Dimming with Soft-On and Fade-to-Black Low End Performance:

a. Dimming Range: 100 to 0.1 percent measured output current.
b. Features smooth fade-to-on and fade-to-black low end dimming performance for incandescent-like dimming experience.
c. Typically dissipates less than 0.5 W standby power at 120/277 V.
d. Complies with FCC requirements of CFR, Title 47, Part 15, for commercial applications at 120/277 V.
e. Class 2 output designed to withstand hot swap of LED loads; meets UL 1310 and CSA C22.2 No. 223.
f. Driver outputs to be short-circuit protected and open-circuit protected.
g. Constant Current Drivers:

1) Support for downlights and pendant fixtures from 150 mA to 1.05 A to ensure compatible driver exists.

a) Support LED arrays up to 20 W.
b) Constant Current Reduction (CCR) dimming method.
c) UL listed Class P.
d) Meets solid state requirements for power factor, transient protection, start time, and operating frequency in Energy Star for Luminaires Version 2.0.

2) Support for troffers, linear pendants, and linear recessed fixtures from 150 mA to 1.05 A to ensure compatible driver exists.

a) Support LED arrays up to 20 W.
b) Constant Current Reduction (CCR) dimming method.
c) UL listed Class P.
d) Meets solid state requirements for power factor, transient protection, start time, and operating frequency in Energy Star for Luminaires Version 2.0.

4. Digital Control, 1 Percent Dimming with Soft-On and Fade-to-Black Low End Performance:

a. Dimming Range: 100 to 1 percent measured output current.
b. Features smooth fade-to-on and fade-to-black low end dimming performance for incandescent-like dimming experience.
c. Typically dissipates less than 0.5 W standby power at 120/277 V.

d. Complies with FCC requirements of CFR, Title 47, Part 15, for commercial applications at 120/277 V.
e. Class 2 output designed to withstand hot swap of LED loads; meets UL 1310 and CSA C22.2 No. 223.
f. Driver outputs to be short-circuit protected and open-circuit protected.
g. Constant Current Drivers:

1) Support for downlights and pendant fixtures from 150 mA to 1.05 A to ensure compatible driver exists.

a) Support LED arrays up to 20 W.
b) Constant Current Reduction (CCR) dimming method.
c) UL listed Class P.
d) Meets solid state requirements for power factor, transient protection, start time, and operating frequency in Energy Star for Luminaires Version 2.0.

2) Support for troffers, linear pendants, and linear recessed fixtures from 150 mA to 1.05 A to ensure compatible driver exists.

a) Support LED arrays up to 20 W.
b) Constant Current Reduction (CCR) dimming method.
c) UL listed Class P.
d) Meets solid state requirements for power factor, transient protection, start time, and operating frequency in Energy Star for Luminaires Version 2.0.

5. Forward Phase (Neutral Wire Required), One Percent Dimming:

a. Dimming Range: 100 to one percent relative light output.
b. Complies with FCC requirements of CFR, Title 47, Part 15, for commercial and residential applications at 120 V.
c. Total Harmonic Distortion (THD): Less than 20 percent at full output for 40 W loads; complies with ANSI C82.11.
d. Constant Current Drivers:

1) Support for downlights and pendant fixtures from 200 mA to 2.1 A to ensure compatible driver exists.

a) Support LED arrays up to 40 W.
b) Pulse Width Modulation (PWM) or Constant Current Reduction (CCR) dimming methods available.
c) UL listed Class P.
d) Meets solid state requirements for power factor, transient protection, start time, and operating frequency in Energy Star for Luminaires Version 2.0.

2) Support for troffers, linear pendants, and linear recessed fixtures from 200 mA to 2.1 A to ensure compatible driver exists.

a) Support LED arrays up to 40 W.
b) Pulse Width Modulation (PWM) or Constant Current Reduction (CCR) dimming methods available.

c) UL listed Class P.
d) Meets solid state requirements for power factor, transient protection, start time, and operating frequency in Energy Star for Luminaires Version 2.0.

3) Support for cove and under-cabinet fixtures from 200 mA to 2.1 A to ensure compatible driver exists.

a) Support LED arrays up to 40 W.
b) Pulse Width Modulation (PWM) or Constant Current Reduction (CCR) dimming methods available.
c) UL listed.
d) Meets solid state requirements for power factor, transient protection, start time, and operating frequency in Energy Star for Luminaires Version 2.0.

e. Constant Voltage Drivers:

1) Support for downlights and pendant fixtures from 10 V to 60 V (in 0.5 V steps) to ensure compatible driver exists.

a) Support LED arrays up to 40 W.
b) Pulse Width Modulation (PWM) dimming method.
c) UL listed Class P.
d) Meets solid state requirements for power factor, transient protection, start time, and operating frequency in Energy Star for Luminaires Version 2.0.

2) Support for troffers, linear pendants, and linear recessed fixtures from 10 V to 60 V (in 0.5 V steps) to ensure compatible driver exists.

a) Support LED arrays up to 40 W.
b) Pulse Width Modulation (PWM) dimming method.
c) UL listed Class P.
d) Meets solid state requirements for power factor, transient protection, start time, and operating frequency in Energy Star for Luminaires Version 2.0.

3) Support for cove and under-cabinet fixtures from 10 V to 60 V (in 0.5 V steps) to ensure compatible driver exists.

a) Support LED arrays up to 40 W.
b) Pulse Width Modulation (PWM) dimming method.
c) UL listed.
d) Meets solid state requirements for power factor, transient protection, start time, and operating frequency in Energy Star for Luminaires Version 2.0.

6. Digital Control, Five Percent Dimming:

a. Dimming Range: 100 to five percent measured output current.
b. Typically dissipates 0.2 W standby power at 120 V and 0.3 W standby power at 277 V.

c. Complies with FCC requirements of CFR, Title 47, Part 15, for commercial applications at 120-277 V.
d. Constant Current Reduction (CCR) dimming method.
e. Total Harmonic Distortion (THD): Less than 21 percent at full load; complies with ANSI C82.11.
f. Constant Current Drivers:

1) Support for downlights and pendant fixtures in currents from 220 mA to 1.4 A to ensure compatible driver exists.

a) Support LED arrays up to 40 W.
b) UL listed Class P.

2) Support for troffers, linear pendants, and linear recessed fixtures from 150 mA to 2.1 A to ensure compatible driver exists.

a) Support LED arrays up to 75 W.
b) Meets solid state requirements for power factor, transient protection, standby power consumption, start time, and operating frequency in ENERGY STAR for Luminaires Version 2.0.
c) Models available to meet DesignLights Consortium (DLC) power line quality requirements.
d) UL listed Class P.

7. Digital Control, One Percent Dimming with Soft-On and Fade-to-Black Low End Performance:

a. Dimming Range: 100 to one percent measured output current.
b. Features smooth fade-to-on and fade-to-black low end dimming performance for incandescent-like dimming experience.
c. Typically dissipates 0.2 W standby power at 120 V and 0.3 W standby power at 277 V.
d. Complies with FCC requirements of CFR, Title 47, Part 15, for commercial applications at 120-277 V.
e. Employs true Constant Current Reduction (CCR) dimming method from 100 to five percent light level and Pulse Width Modulation (PWM) dimming method from five percent to off.
f. Pulse Width Modulation (PWM) frequency of 240 Hz.
g. Total Harmonic Distortion (THD): Less than 20 percent at full output for drivers greater than 25 W; complies with ANSI C82.11.
h. UL Class 2 output.
i. Driver outputs to be short-circuit protected, open-circuit protected, and overload protected.
j. Constant Current Drivers:

1) Support for fixtures from 220 mA to 1.4 A over multiple operating ranges.

a) Support LED arrays up to 40 W.
b) Meets solid state requirements for power factor, transient protection, standby power consumption, start time, and operating frequency in ENERGY STAR for Luminaires Version 2.0.
c) UL listed Class P.

2) Support for fixtures from 150 mA to 2.1 A over multiple operating ranges.

a) Support LED arrays up to 75 W.
b) Meets solid state requirements for power factor, transient protection, standby power consumption, start time, and operating frequency in ENERGY STAR for Luminaires Version 2.0.
c) Models available to meet DesignLights Consortium (DLC) power line quality requirements.
d) UL listed Class P.

2.6 LIGHTING CONTROL MODULES

A. Provide lighting control modules as indicated or as required to control loads as indicated.
B. General Requirements:

1. Listed to UL 508 as industrial control equipment.
2. Delivered and installed as listed factory-assembled panel.
3. Passively cooled via free-convection, unaided by fans or other means.
4. Mounting: Surface.
5. Connection without interface to wired:

a. Occupancy sensors.
b. Daylight sensors.

6. LED status indicators confirm communication with occupancy sensors, daylight sensors, and IR receivers.
7. Supplies power for control link for keypads and control interfaces.
8. Distributes sensor data among multiple lighting control modules.
9. Capable of being controlled via wireless sensors and controls.
10. Contact Closure Input (select models):

a. Directly accept contact closure input from dry contact closure or solid-state output without interface to:

1) Activate scenes.

a) Scene activation from momentary or maintained closure.

2) Enable or disable after hours.

a) Automatic sweep to user-specified level after user-specified time has elapsed.
b) System provides occupants visual warning prior to sweeping lights to user-specified level.
c) Occupant can reset timeout by interacting with lighting system.

3) Activate or deactivate demand response (load shed).

a) Load shed event reduces lighting load by user-specified amount.

11. Emergency Contact Closure Input:

a. Turn all zones to full output during emergency state via direct contact closure input from UL 924 listed emergency lighting interface, security system or fire alarm system.
b. Allow configurable zone response during emergency state.
c. Disable control operation until emergency signal is cleared.

12. Supplies power for control link for keypads and control interfaces (select models).
13. Distributes sensor data among multiple lighting control modules.
14. Capable of being controlled via wireless sensors and controls.

C. Switching Lighting Control Modules:

1. Switching:

a. Rated Life of Relay: Typical of 1,000,000 cycles at fully rated 16 A for all lighting loads.
b. Load switched in manner that prevents arcing at mechanical contacts when power is applied to and removed from load circuits.
c. Fully rated output continuous duty for inductive, capacitive, and resistive loads.
d. Module to integrate up to four individually controlled zones.
e. Utilize air gap off, activated when user selects "off" at any control to disconnect load from line supply.

D. Phase Adaptive Lighting Control Modules:

1. Provides leading-edge or trailing-edge dimming; automatic or manual configuration.
2. Output Zones: One load type per zone.
3. Manual Mode Operation: Provide buttons to turn loads on/off or dim loads up/down for each zone.
4. Manual Override Contact Closure Input: Provides activation of manual override mode; turns all loads on and disables control from other devices.
5. Provide cycle-by-cycle compensation for incoming line voltage variations, including changes in voltage, frequency shifts, harmonics, and line noise; accommodate up to plus/minus two percent change in frequency per second.
6. Comply with NEMA SSL 7A.
7. Capable of withstanding high-inrush LEDs, bulb blowouts, and direct shorts.

E. 0-10V Lighting Control Modules:

1. Coordination Between Low Voltage Dimming Module and Line Voltage Relay: Capable of being electronically linked to single zone.
2. Single low voltage dimming module; capable of controlling the following light sources:

a. 0-10V analog voltage signal.

1) Provide Class 2 isolated 0-10V output signal conforming to IEC 60929.
2) Sink current per IEC 60929.

b. 10V-0V analog voltage signal.
1) Provide Class 2 isolated 0-10V output signal conforming to IEC 60929.
2) Sink current per IEC 60929.

3. Switching:

    a. Rated Life of Relay: Typical of 1,000,000 cycles at fully rated 16 A for all lighting loads.
    b. Load switched in manner that prevents arcing at mechanical contacts when power is applied to and removed from load circuits.
    c. Fully rated output continuous duty for inductive, capacitive, and resistive loads.
    d. Module to integrate up to four individually controlled zones.
    e. When off, the semiconductor in a dimmer circuit can allow leakage current to the
    f. Utilize air gap off, activated when user selects "off" at any control to disconnect load from line supply.

F. Digital Fixture Lighting Control Modules:

1. Provides two-way feedback with digital fixtures for energy monitoring, light level status, lamp failure reporting, and ballast/driver failure reporting.
2. Provide testing capability using manual test buttons.
3. Each low-voltage digital communication link to support up to 64 addresses capable of NFPA 70 Class 1 or Class 2 installation.

G. DALI-2 Lighting Control Modules:

1. Provide testing capability using manual test buttons.
2. Each DALI bus supports:

    a. Control of up to 64 DALI compliant addressable loads, grouped into up to 64 zones.
    b. Up to 250 mA bus power.

2.7 DIN RAIL POWER MODULES

A. Power Module General Requirements:

1. Surge Tolerance: Designed and tested to withstand surges of 6,000 V, 3,000 amps according to IEEE C62.41.2 and IEC 61000-4-5 without impairment to performance.
2. Power: 120 VAC, 50/60 Hz; provide connection as indicated or as required.
3. Communications: Utilize RS485 wiring for low-voltage communications link.
4. Passively cooled via free-convection, unaided by fans or other means.
5. Provide LED indicators for displaying diagnostic information.

B. Switching Power Modules:

1. Output Zones: Each zone rated at 8 A for resistive, inductive, or capacitive lighting loads as defined by IEC 60669-2-1 and NEMA 410, or 1/3 HP motor load; maximum of 16 A per module.
2. Manual Mode Operation: Provide buttons to turn loads on/off for each zone.
3. Emergency Contact Closure Input:

    a. Provides activation of emergency mode; turns all loads on and disables control from other devices.
    b. UL 924 listed.

4. Contact Closure Output:

a. Single contact closure output including both normally open and normally closed dry contacts.
b. Maintained or momentary output.
c. Inductive Loads: Provide flyback diode wired per manufacturer's instructions to control unclamped inductive loads such as relays, solenoids, and motors.

C. Phase Adaptive Power Modules:

1. Provides forward phase or reverse phase dimming; automatic or manual configuration.
2. Output Zones: One load type per zone.
3. Manual Mode Operation: Provide buttons to turn loads on/off or dim loads up/down for each zone.
4. Emergency Contact Closure Input:

a. Provides activation of emergency mode; turns all loads on and disables control from other devices.
b. UL 924 listed.

5. Provide cycle-by-cycle compensation for incoming line variations, including changes in voltage, frequency, harmonics, and line noise; accommodate up to plus/minus two percent change in frequency per second.
6. Systems not providing cycle-by-cycle compensation to include external power conditioning equipment as part of dimming system.
7. Comply with NEMA SSL 7A.

D. 0-10 V Power Modules:

1. Output Zones:

a. Each zone provides 50 mA of 0-10 V dimming control conforming to IEC 60929 Annex E.2; source or sink automatically configures.
b. Relay: Each zone rated for 5 A for switching of incandescent, electronic low voltage, magnetic low voltage, and LED lighting loads.

2. Manual Mode Operation: Provide buttons to turn loads on/off or dim loads up/down for each zone.
3. Emergency Contact Closure Input:

a. Provides activation of emergency mode; turns all loads on and disables control from other devices.
b. UL 924 listed.

E. Digital Fixture Control Modules:

1. Provide testing capability using manual test buttons.
2. Each low-voltage digital communication link to support up to 64 ballasts or LED drivers capable of NFPA 70 Class 1 or Class 2 installation.

F. DALI-2 Fixture Control Modules:

1. Provide testing capability using manual test buttons.
2. Each DALI bus supports:

a. Control of up to 64 DALI compliant addressable loads, grouped into up to 64 zones.
b. Up to 250 mA bus power.

3. Contact Closure Input: Directly accept contact closure input from dry contact closure or solid-state output without interface.
4. Emergency Contact Closure Input:

a. Provides activation of emergency mode; turns all loads on and disables control from other devices.
b. UL 924 listed.

G. DIN Rail Feed-Through Panels: Provide as indicated or as required to house system components.

1. Rated for feed-through, 120/277 VAC applications.
2. Surface or flush mounting.

H. DIN Rail Breaker Panels: Provide as indicated or as required to house system components.

1. Rated for 120 VAC applications.
2. Surface or flush mounting.
3. 15 A and 20 A branch circuit breakers available.
4. Single-phase, 3-wire and three-phase, 4-wire feed types available.
5. Products:

a. 65 inches (165 cm), nominal; for housing up to eight DIN rail power modules, eight branch circuit breakers, and one wire landing board.

2.8 DIGITAL DIMMING BALLAST AND SWITCHING MODULES

A. Provide digital dimming ballast and switching modules as indicated or as required to control loads as indicated.
B. General Requirements:

1. Provide continuous 3-wire signal dimming to compatible 3-wire electronic dimming ballasts.
2. Utilize air gap off to disconnect load from line supply.
3. Generate digital communication commands to distribute ballast and sensor data on digital bus.
4. If power is interrupted and subsequently restored, lights automatically return to setting prior to power interruption.
5. Unique internal reference number visible displayed on module cover.
6. Averages two independent daylight harvesting inputs internally.
7. Responds to digital load shed command.

a. Sets high end trim.
b. Automatically scales light output proportional to load shed command, i.e. if light output is at 30 percent and load shed command of 10 percent is received, ballast to automatically set maximum light output at 90 percent and lower current light output by 3 percent to 27 percent.

8. Provide integral fault protection to prevent ballast module failure in event of miswire.

C. Products:

1. 3-Wire Ballast Module, 2 Amp:

a. Integrates up to 2 amps of 3-wire electronic dimming ballasts into digital control system as single zone.

2. 3-Wire Ballast Module, 16 Amp:

a. Integrates up to 16 amps of 3-wire electronic dimming ballasts into digital control system as single zone.

3.

4. Switching Power Module, 16 Amp:

a. Integrates up to 16 amps of high in-rush lighting load (magnetic fluorescent ballast, electronic fluorescent ballast, HID, incandescent, magnetic low-voltage, electronic low-voltage, neon/cold cathode and motor loads) into digital control system as single zone.

2.9 LIGHTING MANAGEMENT HUBS

A. Supports connection to wired devices; supports connection to processors and wireless gateways via system Ethernet link.
B. Supports communication with wireless devices via wireless gateways.
C. Supports internet connection for automated firmware updates and remote access, diagnostics, and service.
D. Provided in pre-assembled NEMA listed enclosure with terminal blocks listed for field wiring.
E. Connects to controls via RS485.
F. Integrates control station devices, shades, and external inputs into single customizable lighting control system with:

1. Multiple Failsafe Mechanisms:

a. Power failure detection via emergency lighting interface.
b. Protection: Lights go to full on if ballast wires are shorted.
c. Distributed architecture provides fault containment. Single hub failure or loss of power does not compromise lights and shades connected to other lighting management hubs.

2. Manual overrides.
3. Automatic control.

G. Furnished with astronomical time clock.
H. Maintains backup of programming in non-volatile memory capable of lasting more than ten years without power.

2.10 LIGHTING MANAGEMENT SYSTEM SOFTWARE

A. Provide system software and hardware that is designed, tested, manufactured, and warranted by single manufacturer.

B. Configuration Setup Software:

1. Suitable to make system programming and configuration changes.
2. Windows-based, capable of running on either central server or remote client over TCP/IP connection.
3. Back-Up Project Database: Allows user to back up project database that holds configuration information for system, including keypad programming, area scenes, daylighting, occupancy programming, emergency levels, night lights, and time clock.
4. Publish Project Database: Allows user to send new project database to processors and devices. Project database holds configuration information for system, including keypad programming, area scenes, daylighting, occupancy programming, emergency levels, night lights, and time clock.
5. Allows manufacturer (either remotely or with on-site service call); end-user (with training) to:

    a. Capture system design:

        1) Geographical layout.
        2) Load schedule zoning.
        3) The following paragraph would only be included if motorized shades are to be controlled by the lighting control system.
        4) Shade grouping.
        5) Equipment schedule.
        6) Equipment assignment to lighting management hubs.
        7) Daylighting design.

    b. Define configuration for the following in each area:

        1) Lighting scenes.
        2) The following paragraph would only be included if motorized shades are to be controlled by the lighting control system.
        3) Shade group presets.
        4) Control station devices.
        5) Interface and integration equipment.
        6) Occupancy/after hours.
        7) Partitioning.
        8) Daylighting.
        9) Emergency lighting.
        10) Night lights.

    c. Startup:

        1) Addressing.
        2) Daylighting.
        3) Provide customized conditional programming.

C. API Integration:

1. Support communication, without requiring interface, between lighting control system and third-party systems via RESTful API.
2. API Integration Capabilities:

    a. Discovery:

1) Areas: Area and scene names.
2) Zones: Zone names, minimum and maximum light levels.
3) The following paragraph would only be included if motorized shades are to be controlled by the lighting control system.
4) Shade Groups: Shade group and preset names

b. Monitoring:

1) Area Information:

a) Occupancy status.
b) Occupancy enabled.
c) Lighting zone status.
d) Active scene.
e) Instantaneous and maximum lighting power.

2) Zone Information:

a) Light intensity.
b) Switch level.
c) Contact closure output status.
d) Correlated color temperature, where controllable.

c. Control:

1) Lighting Control:

a) Activate scene.
b) Set lighting zone level and correlated color temperature, where controllable.

2) The following paragraph would only be included if motorized shades are to be controlled by the lighting control system.
3) Shade Group Control:

a) Set shade group level.
b) Activate shade group preset.

D. Mobile Application:

1. General Requirements:

a. Constant internet connection to processors and gateways.
b. Support multiple platforms and devices; runs from tablet or mobile phone.
c. Provide functionality listed below available via single application.

2. System Navigation and Operation:

a. Support on-site and remote programming and control of multiple systems from iOS or Android mobile device.
b. Does not require LAN connection to operate. Operates locally or remotely with internet connection to device (e.g., laptop).

c. Navigate between lighting control systems for control.

3. Administration:

   a. Users: Allows new user accounts to be created and existing user accounts to be edited.
   b. Share access to lighting control system for one day, one week, or permanently.

4. Control of Lights:

   a. Modify lighting zone levels and activate scenes, reflected in space in real time.
   b. Make and save adjustments to scenes.
   c. Rename scenes and zones.
   d. Intelligent Light Sources:

      1) Control intensity, correlated color temperature, saturated color, and vibrancy, reflected in space in real time.
      2) Save intensity, correlated color temperature, saturated color, and vibrancy to scenes reflected in space in real time.

   e. DALI Type 8 Tunable-White Drivers:

      1) Control intensity and correlated color temperature reflected in space in real time.
      2) Save intensity and correlated color temperature to scenes reflected in space in real time.

   f. Static-White Drivers:

      1) Control intensity reflected in space in real time.
      2) Save intensity to scenes reflected in space in real time.

5. Control of Shades:

   a. Modify shade group levels and activate shade group presets, reflected in space in real time.
   b. Make and save adjustments to shade presets.

6. Load Shedding*:*

   a. Allow building manager to monitor whole building lighting power usage and apply load shed reduction to selected areas, thereby reducing building's power usage; load shedding triggered via mobile application, BACnet or, RESTful API integration.

7. Scheduling: Schedule time of day and astronomic time clock events to automate functions.

   a. Group scheduled events into timeclock groups.
   b. Enable and disable entire timeclock groups from single place.
   c. Create one-time or recurring scheduled events by day of week, week of month, specific date range.
   d. Exclude scheduled events by holidays or other specific date exclusions.
   e. Enable or disable individual scheduled events.

E. Data Insights Software:

1. One annual license required per system.
2. General Requirements:

a. Web-based; runs on updated browsers including Edge, Chrome, and Safari.
b. Constant internet connection to all Lutron Athena processors and gateways.
c. Support multiple platforms and devices; runs from tablet, desktop, laptop.
d. User interface supports multi-touch gestures such as pinch to zoom, drag to pan, etc.
e. Utilizes HTTPS (industry-standard certificate-based encryption and authentication for security).
f. Provide functionality listed below via single application.

3. System Navigation and Operation:

a. Performed using graphical floor plan view or a generic system layout.
b. Graphical Floor Plan View: Utilize customized CAD based drawing of building. Pan and zoom feature allows for easy navigation; dynamically adjusts details presented based on zoom level.
c. Operate locally or remotely with internet connection.
d. Allow user to navigate through multiple connected lighting control systems spanning multiple buildings.

4. Software Updates:

a. Provide software feature updates, enhancements, and security patches automatically with no disruption to system or space.

5. Reporting: Provide reporting capability that allows building manager to gather real-time and historical information about system.

a. Energy Reports: Show comparison of cumulative energy used over period of time for one or more areas.

1) Capable of displaying historic energy savings in kWh saved.
2) Capable of displaying historical views in time periods (days, weeks, months).

b. Power Reports: Show power usage trend over period of time for one or more areas.

6. Administration:

a. Share user access across entire system including mobile application.

2.11 CONTROL STATIONS

A. Provide control stations with configuration as indicated or as required to control loads as indicated.
B. Touchscreen Control Stations:

1. Touchscreen Interface: 5-inch (127 mm) capacitive touch display; 800 x 400 resolution; touch gesture navigation support; dark and light user interface mode options.

2. Connects to lighting management hubs via system Ethernet link; powered by hub or Ethernet range extender; up to 5 touchscreens per processor; maximum of 328 ft (100 m) between touchscreen and lighting management hub with PoE switch or Ethernet range extender.
3. Control:

    a. Lighting Control: Area, scene, and zone-level control, including intensity, color temperature, and full color with fine-tune adjustment.
    b. Shade Control: Area-level control.
    c. Supports access control via admin and user PINs.

4. Programming: On-screen setup through user-guided interface; requires no additional software.
5. Global Language Support: English, Spanish, French, German, Italian, Portuguese, Simplified Chinese.
6. Finish: To be selected by Architect.

C. Wired Control Stations:

1. General Requirements:

    a. Class 2 devices are low voltage and easy to wire. Conduit, trays, and junction boxes can typically be eliminated. Check with your local electrical code. Class 2 wiring allows for a less expensive installation and flexibility to relocate sensors as building needs dictate.
    b. Power: Class 2 (low voltage).
    c. UL listed.
    d. Provide faceplates with concealed mounting hardware.
    e. Engraving must be durable when exposed to cleaning and normal wear.

        1) Manufacturer to engrave or otherwise label wall stations as directed by Owner after move in and 2 weeks use of space.

    f. Borders, logos, and graduations to use laser engraving or silk-screened graphic process that chemically bonds graphics to faceplate, resistant to removal by scratching and cleaning.
    g. Finish: To be selected by Architect. RAL custom colors may be selected by Architect.

D. Multi-Scene Wired Control:

1. General Requirements:

    a. Allows control of any devices part of lighting control system.
    b. Controls can be programmed with different functionality through system software without any hardware changes.
    c. Allows for easy reprogramming without replacing unit.
    d. Communications: Utilize RS485 wiring for low-voltage communication.
    e. To help occupants understand how to use the lighting control system, engraving requirements should be included for all controls. Engraving details should include text size and style.
    f. Engrave keypads with button, zone, and scene descriptions.

1) Manufacturer to engrave or otherwise label wall stations as directed by Owner after move in and 2 weeks use of space.

g. Software Configuration:
h. Customizable control station device button functionality:

1) Buttons can be programmed to perform single defined action.
2) Buttons can be programmed to perform defined action on press and defined action on release.
3) Buttons can be programmed using conditional logic off of state variable such as time of day or partition status.
4) Buttons can be programmed to perform automatic sequence of defined actions.
5) Capable of deactivating select keypads to prevent accidental changes to light levels.
6) Buttons can be programmed for raise/lower of defined loads.
7) Buttons can be programmed to toggle defined set of loads on/off.

i. Status LEDs:

1) Time delays inherent in large systems can cause short delays between button press and system confirmation. To avoid any confusion and prevent multiple button presses, keypads should immediately show that the button has been pressed for visual confirmation.
2) Upon button press, LEDs to immediately illuminate.
3) There are two types of keypads; those that only send signals and those that send and receive signals. Having the latter type allows feedback to the user to verify that the request has been received and processed. If the lighting control system fails to process the button press request, the LED will turn off to indicate the true system status.
4) LEDs to reflect true system status. LEDs to remain illuminated if button press was properly processed or LEDs to turn off if button press was not processed.
5) Support logic that defines when LED is illuminated:

a) Scene logic (logic is true when all zones are at defined levels).
b) Room logic (logic is true when at least one zone is on).
c) Pathway logic (logic is true when at least one zone is on).
d) Last scene (logic is true when spaces are in defined scenes).

j. Finish: To be selected by Architect.

E. Wired Keypads; Lutron seeTouch QS Keypads:

1. Communications: Utilize RS485 wiring for low-voltage communications link.
2. Mounting: Wallbox or low-voltage mounting bracket; provide wall plates with concealed mounting hardware.
3. Button/Engraving Backlighting:

a. Utilize backlighting for buttons and associated engraving to provide readability under all light conditions.
b. Backlight intensity adjustable via programming software.

4. Design keypads to allow field-customization of button color, configuration, and engraving using field-changeable replacement kits.

    1) Manufacturer to engrave or otherwise label wall stations as directed by Owner after move in and 2 weeks use of space.

5. Contact Closure Interface: Provide two contact closure inputs on back of unit which provide independent functions from front buttons; accepts both momentary and maintained contact closures.
6. Terminal block inputs to be over-voltage and miswire-protected against wire reversals and shorts.
7. Finish: To be selected by Architect.

F. Single-Scene or Zoned Wired Control:

1. Product: Lutron Pico Wired Control.
2. Turn individual fixture or group of fixtures on and off.
3. Raise and lower light levels.
4. Recall favorite light levels.
5. Finish: To be selected by Architect.

G. Wired Keyswitch:

1. Product: Lutron QS Keyswitch.
2. Allows control of any devices part of lighting control system.
3. Communications: Utilize RS485 wiring for low-voltage communications link.
4. Functionality:

    a. Controls can be programmed with different functionality through system software without any hardware changes.
    b. Allows for easy reprogramming without replacing unit.
    c. Requires key insertion to activate actions.

5. Software Configuration:

    a. Customizable control station device button functionality:

        1) Key positions can be programmed to perform single defined action.
        2) Key positions can be programmed using conditional logic off of state variable such as time of day or partition status.
        3) Manufacturer to engrave or otherwise label wall stations as directed by Owner after move in and 2 weeks use of space.

6. Design keypads to allow field-customization of button color, configuration, and engraving using field-changeable replacement kits.

    1) Manufacturer to engrave or otherwise label wall stations as directed by Owner after move in and 2 weeks use of space.

7. Finish: To be selected by Architect.

H. Wireless (Radio Frequency) Controls:

1. Products:

    a. 2-Button Control; Lutron Pico Wireless Control Model PJ2-2B; or Lutron Pico Wireless Control Module UPJ2-2B (BAA-Buy American Act Compliant).
    b. 3-Button Control; Lutron Pico Wireless Control Model PJ2-3B; or Lutron Pico Wireless Control Module UPJ2-3B (BAA-Buy American Act Compliant).
    c. 3-Button with Raise/Lower Control; Lutron Pico Wireless Control Model PJ2-3BRL; or Lutron Pico Wireless Control Module UPJ2-3BRL (BAA-Buy American Act Compliant)>.
    d. 4-Button; <Lutron Pico Wireless Control Model PJ2-4B; or Lutron Pico Wireless Control Module UPJ2-4B (BAA-Buy American Act Compliant)>.
    e. Single Pedestal; Lutron Pico Pedestal Model L-PED1.
    f. Double Pedestal; Lutron Pico Pedestal Model L-PED2.
    g. Triple Pedestal; Lutron Pico Pedestal Model L-PED3.
    h. Quadruple Pedestal; Lutron Pico Pedestal Model L-PED4.
    i. Screw Mounting Kit; Lutron Model PICO-SM-KIT.
    j. Wallbox Adapter; Lutron Model PICO-WBX-ADAPT.

2. Quantity: As indicated on drawings
3. Communicates via radio frequency to compatible dimmers, switches, and plug-in modules.
4. Does not require external power packs, power or communication wiring.
5. Controls can be programmed with different functionality through system software without any hardware changes.
6. Allows for easy reprogramming without replacing unit.
7. Button Programming:

    a. Single action.
    b. Toggle action.

8. Includes LED to indicate button press or programming mode status.
9. Mounting:

    a. Capable of being mounted with table stand or directly to wall under faceplate.
    b. Faceplates: Provide concealed mounting hardware.

10. Power: Battery-operated with minimum ten-year battery life.
11. Finish: To be selected by Architect.
12. Design keypads to allow field-customization of button color, configuration, and engraving using field-changeable replacement kits.

        1) Manufacturer to engrave or otherwise label wall stations as directed by Owner after move in and 2 weeks use of space.

2.12 LOW-VOLTAGE CONTROL INTERFACES

A. Provide low-voltage control interfaces as indicated or as required to control loads as indicated.
B. All devices shall be UL listed.
C. Contact Closure Interface:

1. Product: Lutron Model QSE-IO.
2. Connects to lighting management hub via RS485.

3. The contact closure input device to accept both momentary and maintained contact closures.
4. The contact closure output device can be configured for maintained or pulsed outputs.
5. Contact closure can be programmed using conditional logic off of state variable such as time of day or partition status.

D. Wallbox Input Closure Interface:

1. Product: Lutron Model QSE-CI-WCI.
2. Connects to lighting management hub via RS485.
3. Mounts in wallbox behind contact closure keypad to provide interface for up to eight contact closure inputs.
4. The contact closure input device to accept both momentary and maintained contact closures.

E. RS232 and Ethernet Interface:

1. Product: Lutron Model QSE-CI-NWK-E.
2. Connects to lighting management hub via RS485.
3. Provide ability to communicate via Ethernet or RS232 to audiovisual equipment, touchscreens, etc.
4. Provide control of:

    a. Light scene selections.
    b. Fine-tuning of light scene levels with raise/lower.
    c. Shade group presets.
    d. Fine-tuning of shade preset levels with raise/lower.
    e. Simulate system wall station button presses and releases.

5. Provide status monitoring of:

    a. Light scene status.
    b. Shade group status.
    c. Wall station button presses and releases.
    d. Wall station LEDs.

6. Provide ability to send custom output strings.

F. DMX Interface:

1. Product: Lutron Model QSE-CI-DMX.
2. Connects to lighting management hub via RS485.
3. Provide ability to:

    a. Map single zone intensity to single DMX512 lighting channel.
    b. Map single zone intensity to three DMX512 channels for RGB/CMY color control.
    c. Map a single zone intensity to a single DMX512 integration channel.
    d. Smoothly transition from one color to another in crossfade.
    e. Automatically sequence through variety of colors.

G. Sensor Modules:

1. Products:

a. Sensor module with both wired and wireless inputs*; Lutron Model QSM2-4W-C*.
b. Sensor module with wired inputs only*; Lutron Model QSMX-4W-C*.
c. Sensor module with wireless inputs only*; Lutron Model QSM2-XW-C*.

2. Connects to lighting management hub via RS485.
3. Wired Modules:

a. Provide wired inputs for:

1) Occupancy sensors.
2) Daylight sensors.
3) Wired wall stations.

4. Wireless Modules:

a. Provide wireless communication inputs for:

1) Occupancy sensors.
2) Daylight sensors.
3) Manual controls.

b. RF Range: 30 feet (9 m) between sensor module and compatible RF transmitting devices.
c. RF Frequency: 434 MHz; operates in FCC governed frequency spectrum for periodic operation; continuous transmission spectrum is not permitted.

5. Communicate sensor information to wired low-voltage digital link for use by compatible devices.

H. Wireless Gateway:

a. Product: Lutron Athena Clear Connect Gateway – Type X; Model Q-RF.
b. Connects to lighting management hub via system Ethernet link; powered by *Athena QP5* hub or *Q-POE-PNL* Ethernet range extender.
c. Enables lighting control system to communicate with up to 100 *Clear Connect – Type X* wireless devices*, including Ketra intelligent light sources*.
d. RF Range: Maximum of 75 feet (23 m) between wireless gateway and compatible *Clear Connect – Type X* wireless devices on same floor; maximum of 25 feet (7.6 m) between each *Clear Connect – Type X* wireless device and at least two other *Clear Connect – Type X* wireless devices.

I. Automatic Demand Response Interface:

1. Product: Lutron Automated Demand Response Kit; Model LUT-Q-OPNADR-CPN8064.
2. Connects to lighting management hub via RS485; requires internet connection to connect to utility demand response server.
3. Supports automatic demand response for load shedding via OpenADR® 2.0b compliant utility command.

J. Infrared Partition Sensors:

1. Provide contact closure based on status of partition wall (open/close) enabling automatic linking of controls.

2.13 POWER INTERFACES

A. Provide power interfaces as indicated or as required to control the loads as indicated.
B. Electrical Requirements:

1. Phase independent of control input.
2. Dimmer to meet limited short circuit test as defined in UL 508A.
3. Rated for use in air-handling spaces as defined in UL 2043.
4. Utilize air gap off to disconnect the load from line supply.
5. Diagnostics and Service: replacing power interface does not require re-programming of system or processor.

C. Product(s):

1. Phase adaptive power module [PHPM-PA]

a. Provides interface for phase control input to provide full 16 A circuit output of forward/reverse phase control for compatible loads.
b. Output can be 120V or 277V.
c. Compatible loads include: incandescent, magnetic low voltage (MLV), electronic low voltage (ELV), and neon/cold cathode.

2. Switching Power Module [PHPM-SW]

a. Provides interface for phase control or switched input to provide full 16 A circuit output of switching for compatible non-dim loads.
b. Output can be 120V or 277V.
c. Compatible with non-dim loads.

3. Electronic Low Voltage (ELV) Power Interface [NGRX-ELVI/ELVI-1000]

a. Power interface that takes phase control input and provides full 8 A circuit output to electronic low voltage (ELV) transformers.

4. Pulse width modulation (PWM) Power Interface [GRX-PWM]

a. Power interface that takes phase control input and provides full 16 A circuit output to PWM dimming or switching loads.

5. Ten Volt Power Interface [GRX-TVI]

a. Power interface that takes phase control input and provides full 16 A circuit output to compatible 0-10V dimming and switch loads.
b. Input and Output can be 120V or 277V.
c. Compatible loads include: 0-10V electronic dimming and switching drivers and ballasts.
d. Up to (5) 10V interfaces may be connected to one Control Unit Zone for one zone to control up to (5) 16A circuits of electronic dimming drivers and ballasts.

6. Contact Closure Input Interface; [GRX-WCI]

    a. Directly accept contact closure input from a dry contact closure or sold-state output without interface to:

        1) Activate scenes.

            a) Scene activation from momentary or maintained closure.

        2) Enable or disable after hours.

            a) Automatic sweep to user-specified level after user-specified time has elapsed.
            b) System will provide occupants a visual warning prior to sweeping lights to user-specified level.
            c) Occupant can reset timeout by interacting with the lighting system.

        3) Activate or deactivate demand response (load shed).

            a) Load shed event will reduce lighting load by user-specified amount.

7. Contact Closure Interfaces; [GRX-IO]

    a. The contact closure input device will accept both momentary and maintained contact closures.
    b. The contact closure output device can be configured for maintained or momentary outputs.

8. Contact Closure Output Interface; [GRX-CCO-8]

    a. The contact closure output device can be configured for maintained or momentary outputs.

9. Emergency Contact Closure Input Interface

    a. Turn all zones to full output during emergency state via direct contact closure input from UL 924 listed emergency lighting interface, security system or fire alarm system.
    b. Allow configurable zone response during emergency state.
    c. Disable control operation until emergency signal is cleared.

10. Astronomical Timeclock and Programmer Interface; [GRX-CI-PRG]:

    a. Provide ability to communicate by means of RS232 serial communication to GRX-4000 series system by means of user-supplied PC or digital audiovisual equipment. Control to be located within 50 feet (15 meters) of RS232 source.
    b. Provide ability to communicate by means of TCP/IP over Ethernet to GRAFIK Eye 4000 system by means of user-supplied PC or digital audiovisual equipment. Control to be located within 300 feet (100 meters) of Ethernet source.
    c. Astronomical time clock and programmer interface

1) Provide access to:

a) Scene selections.
b) Fade zone to a level.
c) Fine-tuning of preset levels with scene raise/lower.
d) Lock out scenes and zones.
e) Fine-tuning of light levels with individual zone raise/lower.
f) Enable/disable wall station.
g) Software to provide as follows:
h) System setup
i) Program low voltage controls.
j) Set up and run time clock schedules.
k) Set up and run sequences.
l) Set and report time.
m) Archive system information.
n) Provide status monitoring through button feedback and scene-status updates.

2.14 LIGHTING CONTROL MODULES

A. Provide lighting control interfaces and modules as indicated or required to control the loads as indicated.
B. General requirements:

1. Listed to UL 508 as industrial control equipment.
2. Delivered and installed as a listed factory-assembled panel.
3. Passively cooled via free convection, unaided by fans or other means.
4. Mounting: surface
5. Connection without interface to wired:

a. Occupancy sensors.
b. Daylight sensors.
c. IR receivers for personal control.

6. LED status indicators confirm communication with occupancy sensors, daylight sensors, and IR receivers.
7. Supplies power for control link for keypads and control interfaces.
8. Distributes sensor data among multiple lighting control modules.
9. Capable of being controlled via wireless sensors and controls.

C. Switching Lighting Control Modules:

1. Switching:

a. Rated Life of Relay: Typical of 1,000,000 cycles at fully rated 16 A for all lighting loads.
b. Load switched in manner that prevents arcing at mechanical contacts when power is applied to and removed from load circuits.
c. Fully rated output continuous duty for inductive, capacitive, and resistive loads.
d. Module to integrate up to four individually controlled zones.
e. Utilize air gap off, activated when user selects "off" at any control to disconnect the load from line supply.

D. 0-10V Lighting Control Modules:

1. Coordination between Low Voltage Dimming Module and Line Voltage Relay: Capable of being electronically linked to single zone.
2. Single low voltage dimming module; capable of controlling following light sources:

a. 0-10 V analog voltage signal.

1) Provide Class 2 isolated 0-10 V output signal conforming to IEC 60929.
2) Sink current per IEC 60929.

b. 10-0 V analog voltage signal.

1) Provide Class 2 isolated 0-10 V output signal conforming to IEC 60929.
2) Sink current per IEC 60929.

3. Switching:

a. Rated Life of Relay: Typical of 1,000,000 cycles at fully rated 16 A for all lighting loads.
b. Load switched in manner that prevents arcing at mechanical contacts when power is applied to and removed from load circuits.
c. Fully rated output continuous duty for inductive, capacitive, and resistive loads.
d. Module to integrate up to four individually controlled zones.
e. Utilize air gap off, activated when user selects "off" at any control to disconnect the load from line supply.

E. Digital Fixture Lighting Control Modules:

1. Provides two-way feedback with digital fixtures for energy monitoring, light level status, lamp failure reporting, and ballast/driver failure reporting.
2. Provide testing capability using manual override buttons.

2.15 Low Voltage Control Interfaces

A. Provide low-voltage control interfaces as indicated or required to control the loads as indicated.
B. All devices shall be UL listed.
C. Product(s):

1. Infrared Interface; [Lutron GRX-IRI]:

a. Integrate third party infrared controls into preset lighting control system.

2. Sivoia Quiet Electronic Drive (QED) Controller; [Lutron Model SG-SVCN]:

a. Integrate control of QED shades into preset lighting control system.

3. AC Motor Group Controller; [Lutron Model GRX-4M-GC]:

a. Integrate control of AC motor shades into preset lighting control system.

4. Radio Frequency Interface; [Lutron Model RA-GRXI-WH]:

5. Automatic Daylighting Control Interface; [Lutron Model GRX-DACPI]:

    a. Provide automatic scene selection in response to ambient daylight

2.16 SENSORS

A. Provide following devices where indicated by Engineer
B. Product(s):

1. Ceiling-Mounted Infrared Receiver; [Lutron Model GRX-CIR-WH]:
    a. Ceiling-Mounted Infrared Receivers have 360 degree reception of wireless infrared remote controls.

2. Interior Daylight Sensors; [Lutron Model MW-FPS-WH]:

    a. Use Class 2 wiring for low voltage communication
    b. Can be replaced without reprogramming
    c. Open-loop basis for daylight sensor control scheme
    d. Stable output over temperature from 0 degrees C to 40 degrees C
    e. Partially shielded for accurate detection of available daylight to prevent fixture lighting and horizontal light component from skewing sensor detection
    f. Provide linear response from 0 to 500 foot-candles
    g. Constructed with plastic meeting UL94 HB
    h. Mountable on lighting fixtures or recessed acoustical ceiling tiles
    i. Glue or other chemical adhesives can become caustic or brittle at high temperatures. EcoSystem daylight sensors and infrared receivers are constructed without the use of glue or adhesives to prevent part separation or noxious gas emissions
    j. Constructed via sonic welding
    k. Color:

        1) Match NEMA WD1, Section 2 White
        2) Color variation in same product family: Maximum ΔE=1, CIE L*a*b color units
        3) Daylight generates ultraviolet light which can cause parts that do not meet ASTM D4674-89 to discolor / yellow over time.
        4) Visible parts: Exhibit ultraviolet color stability when tested with multiple actinic light sources as defined in ASTM D4674. Provide proof of testing upon request.

3. Exterior Daylight Sensors:

    a. Calibrated with independent turn-on and turn-off thresholds; minimum 2 foot-candles difference between the turn-on and turn-off thresholds.
    b. Enclosed in weatherproof housing with shading and lens protection visor.

4. Ceiling and Wall Mount Occupancy/Vacancy Sensors

    a. Sensing mechanism:

1) [Infrared]: Utilize multiple segmented lens, with internal grooves to eliminate dust and residue build-up.
2) [Ultrasonic]: Utilize an operating frequency of 32kHz or 40kHz that shall be crystal controlled to operate within plus or minus 0.005 percent tolerance.
3) [Dual technology]:

    a) Utilize multiple segmented lens, with internal grooves to eliminate dust and residue build-up.
    b) Utilize an operating frequency of 32kHz or 40kHz that shall be crystal controlled to operate within plus or minus 0.005 percent tolerance.

b. Sensors shall turn off or reduce lighting automatically after reasonable time delay when a room or area is vacated by the last person to occupy the space
c. Sensor shall accommodate all conditions of space utilization and all irregular work hours and habits.
d. Edit subparagraph below retaining only those standards necessary to meet project requirements.
e. Sensors shall be UL listed
f. Sensors shall be fully adaptive and adjust their sensitivity and timing to ensure optimal lighting control for any use of the space
g. Sensors shall have field adjustable controls for time delay and sensitivity to override any adaptive features.
h. Power dropouts occur frequently. When power is restored, the lighting system should recover quickly and automatically return to the last lighting levels. A momentary interruption (1 or 2 seconds) of power should not cause extended periods (20 seconds or more) without lighting while the system reboots and all other electrical equipment is back on.
i. Power failure memory:

    1) Controls incorporate non-volatile memory. Should power be interrupted and subsequently restored, settings and learned parameters saved in protected memory shall not be lost.

j. Provide all necessary mounting hardware and instructions.
k. Sensors shall be Class 2 devices.
l. Indicate viewing directions on mounting bracket for all Ceiling mount sensors.
m. Provide customizable mask to block off unwanted viewing areas for all ceiling mounted sensors using infrared technology.
n. Provide swivel mount base for all wall mount sensors.
o. Provide an internal additional isolated relay with Normally Open, Normally Closed and Common outputs for use with HVAC control, Data Logging and other control options.

5. Sensor Power Packs

    a. For ease of mounting, installation and future service, power pack(s) shall be able to mount through a 1/2" knock-out in a standard electrical enclosure and be an integrated, self-contained unit consisting internally of an isolated load switching control relay and a transformer to provide low-voltage power. Transformer shall provide power to a minimum of three (3) sensors.
    b. Power pack shall be plenum rated

c. Control wiring between sensors and control units shall be Class 2, 18-24 AWG, stranded U.L. Classified, PVC insulated or TEFLON jacketed cable suitable for use in plenums, where applicable

2.17 ACCESSORIES

A. Provide following devices where specified by Electrical Engineer:
B. Emergency Lighting Interface;

1. Provides total system listing to UL924 when used with Lutron GRAFIK Eye 4000 system.
2. Senses all three phases of building power.
3. Provides an output to power panels or Digital Interfaces if power on any phase fails and sends all lights controlled by these devices to an emergency light level setting, which is 100 percent intensity. Lights shall return to their previous intensities when normal power is restored.
4. Accepts a contact closure input from a fire alarm control panel.

C. Tamper Proof Covers:

1. Locking covers for preset control units and wall stations: Reversible to allow lock to be located on either side of control.
2. Compatible with IR controls.
3. Does not reduce specified IR range by more than 50 percent of its original specification.

D. Infrared Transmitters:

1. Provide wireless remote control capable of recalling preset light levels for [four] [eight] scenes plus “off” and of fine-tuning light levels with master raise/lower.
2. Designed for use in conjunction with compatible infrared receiver and lighting control; dependent on that receiver, not transmitter.
3. Operate up to 15 meters (50 feet) within line-of-sight to that receiver.
4. “Learnable” by other variable frequency remote controls.

2.18 WIRING DEVICE ACCESSORIES

A. General

1. Provide wall plate kits that are designed, tested, manufactured, warranted, and provided by a single manufacturer unless otherwise noted.
2. Provide seamless faceplates with no visible means of attachment.
3. Color

a. Color to be selected by Architect.
b. Color variation in same product family: Maximum ΔE=1, CIE L*a*b color units.
c. Visible parts: Exhibit ultraviolet color stability when tested with multiple actinic light sources as defined in ASTM D4674. Provide proof of testing upon request.

B. Wall Plates

1. Listed to UL 514C, CSA C22.2 #42.1-00
2. Provide an adapter plate for proper device alignment and wall plate attachment.

3. Product: Designer style face plates: Claro Gloss, Matte Finish. Wall plate styles and colors to be provided as defined on the project drawings and schedules

2.19 SOURCE QUALITY CONTROL

A. To ensure that 100 percent of the lighting control products work at installation, the manufacturer should test 100 percent of all assemblies at full rated load in the factory. This testing will assure that every product has been tested and guaranteed to work. Sampling would only prove that the samples work and should not be acceptable.
B. Perform full-function testing on all completed assemblies at end of line. Statistical sampling is not acceptable.
C. To ensure that 100 percent of the lighting control products work at installation, the manufacturer should test 100 percent of all assemblies at full rated load in the factory. This testing will assure that every product has been tested and guaranteed to work. Sampling would only prove that the samples work and should not be acceptable.
D. Audit burn-in at 40 degrees C (104 degrees F) ambient temperature of dimming assemblies and panels at full load for two hours.
E. Sample burn-in is used to verify the consistency of quality for the supplied devices and manufacturing processes so that they meet the design intent.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install equipment in accordance with manufacturer’s installation instructions.
B. Provide complete installation of system in accordance with Contract Documents.
C. In order for the system to be fully commissioned and operating to specification, a database will need to be created. It is critical that the manufacturer receive information on load and control functionality so that the database can be written and fully tested by the manufacture.
D. Define each dimmer's load type, assign each load to a zone, and set control functions.
E. Provide equipment at locations and in quantities indicated on Drawings. Provide any additional equipment required to provide control intent.
F. In order for the exterior daylight sensor to respond to daylight during the entire daylight period, the sensor should face north so that in the morning it will see daylight from the east and in the evening it will see daylight from the west. Directing the sensor due north also minimizes direct lighting exposure to the sensor which could overload the sensor.
G. Mount daylight sensors to point due north with constant view of daylight.

1. Interior sensor work mainly with diffused light, as such, they have a much higher lighting gain than exterior sensors. Electric light sources can affect these sensors unless the sensors are shielded from the light given off by electric light sources.
2. Ensure that daylight sensor placement minimizes sensors view of electric light sources; ceiling mounted and fixture-mounted daylight sensors shall not have direct view of luminaries.

H. Systems Integration

1. Equipment Integration Meeting Visit (LSC-INT-VISIT)

a. Facility Representative to coordinate meeting between Facility Representative, Lighting Control System Manufacturer and other related equipment manufacturers to discuss equipment and integration procedures.

3.2 Sequence of operation

A. Site and Terraces

1. Lighting shall be controlled by Lighting Control System Software, wall recessed touch panel control station, photocells, and astronomical timeclock.
2. The lighting scenes shall be triggered by the astronomical timeclock function and photocells with override by the touch panel control station.
3. Under overcast sky conditions, the photocells shall trigger the lighting.
4. Fixtures shall be grouped together into zones as indicated in the zone control diagrams shown in the on the Electrical Drawings.
5. Allow for programming of 2 scenes + off as directed by lighting consultant during field commissioning.

B. Facade

1. Lighting shall be controlled by Lighting Control System Software, wall recessed touch panel control station, and astronomical timeclock.
2. The lighting scenes shall be triggered by the astronomical timeclock function and photocells with override by the touch panel control station.
3. Façade lighting shall turn off at midnight and 6 a.m. per LEED requirements.
4. Fixtures shall be grouped together into zones as indicated in the zone control diagrams shown in the on the Electrical Drawings.
5. Allow for programming of 2 scenes + off as directed by lighting consultant during field commissioning.

C. Atrium

1. Lighting shall be controlled by Lighting Control System Software, wall recessed touch panel control station, daylight sensors, and astronomical timeclock.
2. The lighting scenes shall be triggered by the astronomical timeclock with override by the touch panel control station.
3. Daylight dimming shall be provided for the lighting within 15 feet of the perimeter windows. When sufficient illumination is provided by daylight, the light fixtures in the daylight zone shall dim to 1% light output.
4. Fixtures shall be grouped together into zones as indicated in the zone control diagrams shown in the on the Electrical Drawings.
5. Allow for programming of 4 scenes + off as directed by lighting consultant during field commissioning.

D. Elevator Lobbies

1. Lighting shall be controlled by Lighting Control System Software, wall recessed touch panel control station, and astronomical timeclock.
2. The lighting scenes shall be triggered by the astronomical timeclock function with override by the touch panel control station.
3. Fixtures shall be grouped together into zones as indicated in the zone control diagrams shown in the on the Electrical Drawings.

4. Allow for programming of 4 scenes + off as directed by lighting consultant during field commissioning.

E. Security Screening Areas

1. Lighting shall be controlled by Lighting Control System Software, wall recessed touch panel control station, daylight sensors, and astronomical timeclock.
2. The lighting scenes shall be triggered by the astronomical timeclock function with override by the touch panel control station.
3. Fixtures shall be grouped together into zones as indicated in the zone control diagrams shown in the on the Electrical Drawings.
4. Allow for programming of 4 scenes + off as directed by lighting consultant during field commissioning.

F. Monumental Stair

1. Lighting shall be controlled by Lighting Control System Software, wall recessed touch panel control station, daylight sensors, occupancy sensors, and astronomical timeclock.
2. The lighting scenes shall be triggered by the astronomical timeclock function with override by the touch panel control station and occupancy sensors.
3. Occupancy sensors shall be dual technology and shall be operable after normal business hours only.
4. After normal business hours, the occupancy sensors will detect whether a person is present in the room and activate the system.
5. After normal business hours, occupancy sensors will dim the lighting when the space has been vacated – after 20 minutes, unless another time has been requested by the Owner.
6. Fixtures shall be grouped together into zones as indicated in the zone control diagrams shown in the on the Electrical Drawings.
7. Allow for programming of 4 scenes + off as directed by lighting consultant during field commissioning.

G. Courtrooms

1. Lighting shall be controlled by Lighting Control System Software, wall recessed touch panel control station, five-scene preset lighting keypad with raise/lower, daylight sensors, occupancy sensors, and RS232 A/V Interface.
2. The lighting scenes shall be triggered by the occupancy sensors with override by the touch panel control station, five-scene preset lighting keypad with raise/lower, and A/V touch panel.
3. Occupancy sensors shall be dual technology and shall be enabled 24 hours a day/7 days per week, unless otherwise specified by facilities.
4. The occupancy sensors will detect whether a person is present in the room and turn the lighting on to no more than 50% of the lighting power.
5. Occupancy sensors will turn the lighting off when the room has been vacated – after 20 minutes, unless another time has been requested by facilities.
6. Provide (1) RS232 A/V interface per space.
7. RS232 A/V interface will allow activation of lighting scenes from the A/V touchscreen – A/V installer must provide programming for A/V to allow this function.
8. Daylight dimming shall be provided for the lighting within 15 feet of the perimeter windows. When sufficient illumination is provided by daylight, the light fixtures in the daylight zone shall dim to 1% light output.
9. Fixtures shall be grouped together into zones as indicated in the zone control diagrams shown in the on the Electrical Drawings.

10. Allow for programming of 4 scenes + off as directed by lighting consultant during field commissioning.

H. Conference Rooms

1. Lighting shall be controlled by Lighting Control System Software, wall recessed touch panel control station, five-scene preset lighting keypad with raise/lower, daylight sensors, occupancy sensors, and RS232 A/V Interface.
2. The lighting scenes shall be triggered by the occupancy sensors with override by the five-scene preset lighting keypad with raise/lower and A/V touch panel.
3. Occupancy sensors shall be dual technology and shall be enabled 24 hours a day/7 days per week, unless otherwise specified by facilities.
4. The occupancy sensors will detect whether a person is present in the room and turn the lighting on to no more than 50% of the lighting power.
5. Occupancy sensors will turn the lighting off when the room has been vacated – after 20 minutes, unless another time has been requested by facilities.
6. Provide (1) RS232 A/V interface per space.
7. RS232 A/V interface will allow activation of lighting scenes from the A/V touchscreen – A/V installer must provide programming for A/V to allow this function.
8. Daylight dimming shall be provided for the lighting within 15 feet of the perimeter windows. When sufficient illumination is provided by daylight, the light fixtures in the daylight zone shall dim to 1% light output.
9. Fixtures shall be grouped together into zones as indicated in the zone control diagrams shown in the on the Electrical Drawings.
10. Allow for programming of 4 scenes + off as directed by lighting consultant during field commissioning.

I. Divisible Training Rooms

1. Lighting shall be controlled by Lighting Control System Software, wall recessed touch panel control station, five-scene preset lighting keypad with raise/lower, occupancy sensors, partition sensors, and RS232 A/V Interface.
2. The lighting scenes shall be triggered by the occupancy sensors with override by the five-scene preset lighting keypad with raise/lower and A/V touch panel.
3. Occupancy sensors shall be dual technology and shall be enabled 24 hours a day/7 days per week, unless otherwise specified by facilities.
4. The occupancy sensors will detect whether a person is present in the room and turn the lighting on to no more than 50% of the lighting power.
5. Occupancy sensors will turn the lighting off when the room has been vacated – after 20 minutes, unless another time has been requested by facilities.
6. Provide (1) RS232 A/V interface per space.
7. RS232 A/V interface will allow activation of lighting scenes from the A/V touchscreen – A/V installer must provide programming for A/V to allow this function.
8. Partition sensor [QSE-IO] will activate partition control. This feature will allow rooms with folding partition walls to operate collectively when the partition is open and independently when the partition is closed. A/V installer shall provide programming for this function and coordinate with dimming technician during commissioning.
9. Fixtures shall be grouped together into zones as indicated in the zone control diagrams shown in the on the Electrical Drawings.
10. Allow for programming of 4 scenes + off as directed by lighting consultant during field commissioning.

J. Judge’s Chambers, Justice Chambers, and Workrooms

1. Lighting shall be controlled by Lighting Control System Software, wall recessed touch panel control station, five-scene preset lighting keypad with raise/lower, daylight sensors, occupancy sensors, and RS232 A/V Interface.
2. The lighting scenes shall be triggered by the occupancy sensors with override by the five-scene preset lighting keypad with raise/lower and A/V touch panel.
3. Occupancy sensors shall be dual technology and shall be enabled 24 hours a day/7 days per week, unless otherwise specified by facilities.
4. The occupancy sensors will detect whether a person is present in the room and turn the lighting on to no more than 50% of the lighting power.
5. Occupancy sensors will turn the lighting off when the room has been vacated – after 20 minutes, unless another time has been requested by facilities.
6. Provide (1) RS232 A/V interface per space.
7. RS232 A/V interface will allow activation of lighting scenes from the A/V touchscreen – A/V installer must provide programming for A/V to allow this function.
8. Daylight dimming shall be provided for the lighting within 15 feet of the perimeter windows. When sufficient illumination is provided by daylight, the light fixtures in the daylight zone shall dim to 1% light output.
9. Fixtures shall be grouped together into zones as indicated in the zone control diagrams shown in the on the Electrical Drawings.
10. Allow for programming of 4 scenes + off as directed by lighting consultant during field commissioning.

K. Staff Offices and Visiting Judge Chambers

1. Lighting shall be controlled by Lighting Control System Software, three-scene preset lighting keypad with raise/lower, daylight sensors, and occupancy sensors.
2. The lighting scenes shall be triggered by the occupancy sensors with override by the three-scene preset lighting keypad with raise/lower.
3. Provide (1) three-scene preset lighting keypad with raise/lower wall station per zone of light. Provide dimmer single, double, or triple gang assembly as required based on number of zones designated for each space.
4. Occupancy sensors shall be dual technology and shall be enabled 24 hours a day/7 days per week, unless otherwise specified by facilities.
5. The occupancy sensors will detect whether a person is present in the room and turn the lighting on to no more than 50% of the lighting power.
6. Occupancy sensors will turn the lighting off when the room has been vacated – after 20 minutes, unless another time has been requested by facilities.
7. Daylight dimming shall be provided for the lighting within 15 feet of the perimeter windows, if required by code. When sufficient illumination is provided by daylight, the light fixtures in the daylight zone shall dim to 1% light output.
8. Fixtures shall be grouped together into zones as indicated in the zone control diagrams shown in the on the Electrical Drawings.
9. Allow for programming of 2 scenes + off as directed by lighting consultant during field commissioning.

L. Library

1. Lighting shall be controlled by Lighting Control System Software, wall recessed touch panel control station, five-scene preset lighting keypad with raise/lower, daylight sensors, and occupancy sensors.
2. The lighting scenes shall be triggered by the astronomical timeclock function with override by the touch panel control station and occupancy sensors.

3. Occupancy sensors shall be dual technology and shall be operable after normal business hours only.
4. After normal business hours, the occupancy sensors will detect whether a person is present in the room and activate the system.
5. After normal business hours, occupancy sensors will turn the lighting off when the space has been vacated – after 20 minutes, unless another time has been requested by the Owner.
6. Daylight dimming shall be provided for the lighting within 15 feet of the perimeter windows. When sufficient illumination is provided by daylight, the light fixtures in the daylight zone shall dim to 1% light output.
7. Fixtures shall be grouped together into zones as indicated in the zone control diagrams shown in the on the Electrical Drawings.
8. Allow for programming of 4 scenes + off as directed by lighting consultant during field commissioning.

M. Breakrooms

1. Lighting shall be controlled by Lighting Control System Software, wall recessed touch panel control station, three-scene preset lighting keypads with raise/lower, daylight sensors, and occupancy sensors.
2. The lighting scenes shall be triggered by the occupancy sensors with override by the three-scene preset lighting keypad with raise/lower.
3. Provide (1) three-scene preset lighting keypad with raise/lower wall station per zone of light. Provide dimmer single, double, or triple gang assembly as required based on number of zones designated for each space.
4. Occupancy sensors shall be dual technology and shall be enabled 24 hours a day/7 days per week, unless otherwise specified by facilities.
5. The occupancy sensors will detect whether a person is present in the room and turn the lighting on to no more than 50% of the lighting power.
6. Occupancy sensors will turn the lighting off when the room has been vacated – after 20 minutes, unless another time has been requested by facilities.
7. Daylight dimming shall be provided for the lighting within 15 feet of the perimeter windows, if required by code. When sufficient illumination is provided by daylight, the light fixtures in the daylight zone shall dim to 1% light output.
8. Fixtures shall be grouped together into zones as indicated in the zone control diagrams shown in the on the Electrical Drawings.
9. Allow for programming of 2 scenes + off as directed by lighting consultant during field commissioning.

N. Reception Areas

1. Lighting shall be controlled by Lighting Control System Software, wall recessed touch panel control station, five-scene preset lighting keypad with raise/lower, daylight sensors, occupancy sensors, and astronomical timeclock.
2. The lighting scenes shall be triggered by the astronomical timeclock function with override by the touch panel control station, five-scene preset lighting keypad with raise/lower, and occupancy sensors.
3. Occupancy sensors shall be dual technology and shall be operable after normal business hours only.
4. After normal business hours, the occupancy sensors will detect whether a person is present in the room and activate the system.
5. After normal business hours, occupancy sensors will dim the lighting when the space has been vacated – after 20 minutes, unless another time has been requested by the Owner.

6. Daylight dimming shall be provided for the lighting within 15 feet of the perimeter windows, if required by code. When sufficient illumination is provided by daylight, the light fixtures in the daylight zone shall dim to 1% light output.
7. Fixtures shall be grouped together into zones as indicated in the zone control diagrams shown in the on the Electrical Drawings.
8. Allow for programming of 4 scenes + off as directed by lighting consultant during field commissioning.

O. Secure Corridors

1. Lighting shall be controlled by Lighting Control System Software, wall recessed touch panel control station, daylight sensors, occupancy sensors, and astronomical timeclock.
2. The lighting scenes shall be triggered by the astronomical timeclock function with override by the touch panel control station and occupancy sensors.
3. Occupancy sensors shall be dual technology and shall be operable after normal business hours only.
4. After normal business hours, the occupancy sensors will detect whether a person is present in the room and activate the system.
5. After normal business hours, occupancy sensors will dim the lighting when the space has been vacated – after 20 minutes, unless another time has been requested by the Owner.
6. Daylight dimming shall be provided for the lighting within 15 feet of the perimeter windows, if required by code. When sufficient illumination is provided by daylight, the light fixtures in the daylight zone shall dim to 1% light output.
7. Fixtures shall be grouped together into zones as indicated in the zone control diagrams shown in the on the Electrical Drawings.
8. Allow for programming of 2 scenes + off as directed by lighting consultant during field commissioning.

P. Wellness Center

1. Lighting shall be controlled by Lighting Control System Software, wall recessed touch panel control station, five-scene preset lighting keypad with raise/lower, occupancy sensors, and astronomical timeclock.
2. The lighting scenes shall be triggered by the astronomical timeclock function with override by the touch panel control station, five-scene preset lighting keypad with raise/lower, and occupancy sensors.
3. Occupancy sensors shall be dual technology and shall be operable after normal business hours only.
4. After normal business hours, the occupancy sensors will detect whether a person is present in the room and activate the system.
5. After normal business hours, occupancy sensors will dim the lighting when the space has been vacated – after 20 minutes, unless another time has been requested by the Owner.
6. Fixtures shall be grouped together into zones as indicated in the zone control diagrams shown in the on the Electrical Drawings.
7. Allow for programming of 4 scenes + off as directed by lighting consultant during field commissioning.

Q. Garage Entrance Drives

1. Lighting shall be controlled by Lighting Control System Software, wall recessed touch panel control station, and astronomical timeclock.
2. The lighting scenes shall be triggered by the astronomical timeclock function and photocells with override by the touch panel control station.

3. The light fixtures at the entrance drive shall automatically dim to at least 50% light output from sunset to sunrise.
4. Fixtures shall be grouped together into zones as indicated in the zone control diagrams shown in the on the Electrical Drawings.
5. Allow for programming of 2 scenes + off as directed by lighting consultant during field commissioning.

3.3 SERVICE AND SUPPORT

A. Startup and Programming

1. Provide factory certified field service engineer to make minimum of three site visits to ensure proper system installation and operation under following parameters

a. Qualifications for factory certified field service engineer:

1) Minimum experience of 2 years training in the electrical/electronic field.
2) Certified by the equipment manufacturer on the system installed.

b. Make first visit prior to installation of wiring. Review:

1) Low voltage wiring requirements.
2) Separation of power and low voltage/data wiring.
3) Wire labeling.
4) Lighting Management Panel locations and installations.
5) Control locations.
6) Computer jack locations.
7) Load circuit wiring.
8) Network wiring requirements.
9) Connections to other equipment and other Lutron equipment.
10) Installer responsibilities.
11) Power Panel locations.

c. Make second visit upon completion of installation of Network Lighting Control System:

1) Verify connection of power wiring and load circuits.
2) Verify connection and location of controls.
3) Energize Lighting Management Panels and download system data program.
4) Address devices.
5) Verify proper connection of panel links (low voltage/data) and address panel.
6) Download system panel data to dimming/switching panels
7) Check dimming panel load types and currents and supervise removal of by-pass jumpers.
8) Verify system operation control by control.
9) Verify proper operation of manufacturers interfacing equipment.
10) Verify proper operation of manufacturers supplied PC and installed programs.
11) Configure initial groupings of ballast for wall controls, daylight sensors and occupant sensors.
12) Initial calibration of sensors.
13) Obtain sign-off on system functions.

d. Make third visit to demonstrate and educate Owner's representative on system capabilities, operation and maintenance.

2. Startup

a. Q-Admin configuration

1) Naming and association of areas and lighting zones.

b. After Hours Start-up (LSC-AH-SU)

1) Provide factory certified Field Service Engineer to perform manufacturer's start-up procedures outside normal working hours (Monday through Friday, 7a.m. to 5 p.m.)

B. Tech Support

1. Provide factory direct technical support hotline 24 hours per day, 7 days per week.

3.4 FIELD QUALITY CONTROL

A. Manufacturer Services:

1. Aim and Focus Visit (LSC-AF-VISIT)

a. Facility Representative to coordinate on-site meeting with Lighting Control System Manufacturer and Lighting Design Consultant to make required lighting adjustments to the system for conformance with the Lighting Design Consultant's original design intent.

2. System Optimization Visit (LSC-SYSOPT)

a. Lighting Control System Manufacturer to visit site [6] months after system start-up to evaluate system usage and discuss opportunities to make efficiency improvements that will fit with the current use of the facility.

3.5 CLOSEOUT ACTIVITIES

A. Training Visit (LSC-TRAINING)

1. Lighting Control System Manufacturer to provide [1] day additional on-site system training to site personnel.

B. On-site Walkthrough (LSC-WALK)

1. Lighting Control System Manufacturer to provide a factory certified Field Service Engineer to demonstrate system functionality to the Commissioning Agent.

3.6 MAINTENANCE

A. Capable of providing on-site service support within 24 hours anywhere in continental United States and within 72 hours worldwide except where special visas are required.
B. Offer renewable service contract on yearly basis, to include parts, factory labor, and annual training visits. Make service contracts available up to ten years after date of system startup.

PART 4 - SCHEDULES AND DIAGRAMs

4.1 LIGHTING CONTROL ZONE SCHEDULE

A. See Electrical Drawings

4.2 One Line Diagram

A. See Electrical Drawings

END OF SECTION

This page is intentionally left blank.

SECTION 26 09 43 - LIGHTING CONTROL SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections apply to work of this section.

B. Requirements of the following Division 26 Sections apply to this section:

1. 26 05 02 - Basic Materials and Methods
2. 26 50 00, 26 51 00 - Lighting Fixtures
3. 26 09 36 - Modular Dimming Controls

C. Refer to lighting control drawings for operational intent of the following:

1. Lighting control matrix on drawings for operational intent and device requirement.
2. Typical control diagrams and details.
3. Equipment layout and quantity

1.2 SUMMARY

A. Provide a complete and coordinated network lighting control system with distributed nodes as well as stand-alone room control system.

B. The drawings and specifications indicate control intent for building areas. Where control intent is indicated either on drawings or specifications for a building area, the contractor shall provide that control feature to the entire area, as applicable.

C. The exact quantity of product required (sensors, photocells, power packs, dimmer switches, relay panels, etc.) to meet the control intent, shall be determined by the manufacturer based upon the specific performance of the product. Where a revised quantity of product is required, the contractor shall furnish and install in coordination with the engineer and architect.

D. Types of lighting control equipment specified in this section includes but is not limited to the following:

1. Programmable relay panels
2. Touch screen control stations
3. I/O Modules
4. Power packs
5. Occupancy Sensors
6. Photo Sensors
7. Wall Controllers
8. Relay Control Panels
9. Room Controllers
10. UL924 Rated Devices
11. System Communications Wiring
12. Lighting Control Software

13. A customized software which calendar based (365 days) to provide building wide automatic/remote and manual lighting control for interior and exterior light fixtures.

E. Refer to other Division 26 sections for wires/cables, raceways, electrical boxes and fittings, and wiring devices which are required in conjunction with lighting control equipment to perform work of this section.

F. The following outlines the areas of work to be controlled by this section.

1. General Lighting System Control

a. Interior Lighting: All corridors, restrooms, offices, storage rooms, etc.
b. Exterior Lighting: All pedestrian light poles, façade lighting, parking lot lighting, etc.
c. Dimming: All library spaces, lobbies, conference rooms, courtrooms, etc. shall be fully coordinated with the luminaire driver type for compatibility.
d. Graphic panels and wayfinding signage.
e. Local controls: Where denoted on drawings, local switching, dimming, and occupancy sensors shall be furnished and installed as shown on the drawings, as required by local energy codes, and operate independently of the lighting control system.
f. Daylight controls: all photocell control shall be seen as inputs to the lighting control system.

1.3 SUBMITTALS

Submittal documentation shall be furnished by the manufacturer for approval by the Engineer and must be approved in writing prior to shipment of any equipment from the manufacturer. It shall consist of:

A. Product Data: The manufacturer shall submit in a bill of material form an itemized list of all materials being supplied to meet the specifications.

B. Shop Drawings: Manufacturer shall submit plan drawings of all equipment/components, one-line diagram, relay/dimmer panel schedules, override dimmer/switch station schedules, and plan drawings with all device locations, including photocells, occupancy sensors, switch packs, I/O modules, override dimmer/switch locations, and panel locations. Sensor coverage and quantity shall be provided as part of shop drawings.

C. Riser Diagram: Manufacturer shall submit a line diagram of the system configurations in sufficient detail to show the relative placement of all equipment and interconnection with equipment supplied by other manufacturers.

D. Wiring Diagrams: Manufacturer shall submit typical wiring diagrams for all components. Detailed interconnection diagrams are required only if proper interwiring of components is not clearly indicated on typical wiring diagrams.

E. Plan Drawings: Manufacturer shall submit hard copy color plan drawings showing the type and location of system components including photocells, occupancy sensors, switch packs, I/O Modules, etc. Sensor coverage and quantity shall be verified prior to the preparation of these drawings.

F. Product Overview: Manufacturer shall submit data sheets on all components of the system. These shall describe all hardware and software items provided. A detailed line by line specification compliance shall also be included. The software shall identify the process for programming repeating time schedules.

G. Driver/Lamp Coordination: The contractor shall submit to the manufacturer a complete matrix of all fixture drivers being controlled on the project and their associated control requirement. The manufacturer shall review this list for compatibility with their system components, approve, and provide this matrix in the submittal.

H. Copies: Manufacturer shall provide the quantity of submittals as required by Division 1, “Submittals”.

I. Graphics Screens: Manufacturer shall submit graphic screen layouts as part of a two-step approval process.

1. Contractor shall obtain and provide the manufacturer with current CAD drawings / reflected ceiling plans within 90 days of contract award for development of the graphic screens.
2. Contractor shall obtain and provide the manufacturer with the latest electronic CAD or Revit files for use in creating colored lighting control zone drawings. Colored lighting control concept drawings are available from the design team.
3. Initial Graphics Submittal: Manufacturer shall submit initial graphic screen layouts based on the requirements of this project a minimum of six months prior to substantial completion. Sample graphic screens from other projects are not acceptable.
4. Final Graphics Submittal: Manufacturer shall submit final graphic screen layouts a minimum of 60 days prior to substantial completion.

J. Maintenance Manuals: Furnish maintenance manuals which contain equipment cuts, operating instructions, troubleshooting procedures, and spare parts list for equipment. Ensure manual includes operating instructions in addition to instructions for maintenance of the system’s software package.

1.4 QUALITY ASSURANCE

A. Manufacturer’s Qualifications: The manufacturer shall provide a complete energy saving lighting control system capable of functioning and performing as required by these specifications and the plan drawings. It is the sole responsibility of the Electrical Contractor to ensure that all equipment meets the specifications.

B. Approved manufacturers: Refer to 26 05 03 for approved manufacturers.

C. Sensors shall be of the same manufacturer as the lighting control system.

D. Installer’s Qualifications: The lighting control manufacturing firm shall have a minimum of 5 years of successful installation experience on projects with lighting control equipment work similar to that required for this project.

E. Codes and Standards:

1. Electrical Code Compliance: Comply with applicable local electrical code requirements of the authority having jurisdiction and NEC as applicable to construction, installation of lighting control equipment.
2. UL Compliance: Comply with applicable requirements of UL standard 486A, “Wire Connectors and Soldering Lugs for Use with Copper Conductors”. Provide lighting control equipment and components which are UL-listed and labeled. Any custom cabinets that may be required shall be assembled by a U.L. listed panel shop that is approved for building industrial panels. Each panel shall bear a U.L. label detailing all requirements for industrial panel fabrication.

3. NEMA Compliance: Comply with applicable requirements of NEMA's Standard Pub No. 250, "Enclosures for Electrical Equipment (1000-Volts Maximum)".
4. All lighting control equipment shall be in compliance with FCC Emission Standards specified in Part 15 Subpart J for Class A applications.

1.5 WARRANTY

A. Installation Warranty: A written warranty shall be supplied by the installing contractor agreeing to provide the labor and materials to replace any portion of the lighting control system equipment or wiring that fails due to materials or workmanship for a period of twelve months after substantial completion.

B. Manufacturer's Warranty: A written warranty shall be supplied by the manufacturer agreeing to replace any equipment that fails due to materials or workmanship for a period of 2 years.

C. Warranty Commencement: Warranty shall begin at the point of substantial completion of the system, which is defined as the date when commissioning and owner training has been completed and the Owner obtains beneficial use of the system.

1.6 DELIVERY, STORAGE AND HANDLING

A. Deliver lighting control equipment and components in factory-fabricated type containers or wrappings, which properly protect equipment from damage.

B. Store lighting control equipment in original packaging and protect from weather and construction traffic. Wherever possible, store indoors; where necessary to store outdoors, store above grade and enclose with watertight wrapping.

C. Handle lighting control equipment carefully to prevent physical damage to equipment and components. Do not install damaged equipment; remove from site and replace damaged equipment with new.

PART 2 - PRODUCTS

2.1 SYSTEM REQUIREMENTS

A. System Architecture: The system shall utilize an independent lighting low-voltage communications network to communicate between system components (server, system processors, modules, wall switches, etc.). System shall operate independently of building data network infrastructure and shall not rely on owner or tenant supplied equipment for operation.

B. Network Components: The manufacturer shall provide all network components (routers, switches, gateways, repeaters, etc.) as required to provide a complete distributed network. Network components such as servers, network processors, and network switches shall be provided within wall-mountable enclosures. Where rack-mounted components are provided by the manufacturer, the contractor shall provide wall-mounted network cabinets to house components. The contractor shall coordinate locations of these components within electrical rooms. Each cabinet shall be provided with a rack-mounted PDU with power conditioning to provide power to the network components.

C. Lighting Control Server: Manufacturer shall provide a server to operate the lighting control software. This server shall be integrated into the lighting control equipment cabinets or shall be a rack-mountable server. The server shall be accessed via a remote terminal or web interface.

D. Lighting Control Software: The System shall offer two, separate levels of PC interface: (1) personal lighting control for the average building occupant to control and adjust basic lighting functions in their workspace, and (2) central energy control for the lighting administrator to perform energy management, configuration maintenance, monitoring operations, and providing support to building occupants.

1. GUI: Shall provide a Windows graphical user interface.
2. Central Control: Energy Control Software interface shall provide current status and enable configuration of all System zones including selected individual module availability, current light level, maximum light level, on/off status, occupancy status and emergency mode status.
3. Reports: Energy performance reports shall be printable in a printer friendly format and downloadable for use in spreadsheet applications, etc.
4. Personal Lighting Controls: The Personal Control Software interface shall provide current status and enable each user with the ability to dim and brighten lights, and turn them on and off by module. The Software shall offer user configurable light scenes, which may be programmed and then selected via the Software. Personal lighting control shall be available in open office environments.

E. Dimmers and preset dimming lighting controls shall operate the following sources/load types with a smooth continuous Square Law dimming curve. Dimmers shall also be capable of operating these sources on a non-dim basis. Dimmers shall be electronically assigned to the appropriate load type/dimming curve and can be reassigned at any time. Universal-type dimmers that do not adjust the dimming curve shall not be acceptable.

1. LED Drivers: Drivers and control modules shall be fully compatible and tested to ensure intended working operation.

    a. 0-10V Dimming shall provide dimming to specified level as listed on drawings.
    b. Phase Dimming including leading edge (forward phase), and trailing edge (reverse phase).

2. Magnetic Low-Voltage Transformer

    a. Dimmer shall contain circuitry specifically designed to control and provide a symmetrical AC waveform to the input of magnetic low-voltage transformers.
    b. Dimmer shall not cause a magnetic low-voltage transformer to operate above the transformer’s rated operating current and temperature.
    c. Dimmer shall contain circuitry to control dioded lamps.

3. Electronic Low-Voltage Transformer

    a. No flicker or interaction shall occur at any point in the dimming range.
    b. For integral dimming, an interface shall be required.

4. Non-Dim/Switched Loads

F. Non-dim shall be rated to 16A of resistive, tungsten, induction, or capacitive loads. Non-dim shall incorporate an air gap relay to open circuit when load is off.

G. Daylight Harvesting (Light Regulation Averaging): In a photo sensor-equipped System, the system processors shall rationalize changes to light levels when ambient (natural) light is available and shall maintain a steady light level when subjected to fluctuating ambient conditions. System shall utilize light level inputs from common and/or remote sensor locations to minimize the number of photo sensors required. The System shall operate with multiple users in harmony and not react adversely to manual override inputs. Daylight harvesting shall not impede personal lighting control and the ability to adjust light levels on a per fixture basis.

H. Time Clock Scheduling: The System shall be programmable for scheduling lights on or off via the Energy Control Software interface.

1. Override: Manual adjustments and occupancy sensor detection shall temporarily override off status imposed by time clock schedule.
2. Response to Power Failure: In the event of a power failure, the time clock shall execute schedules that would still be in progress had they begun during the power outage.
3. Flick warning: Each load shall be programmable to provide a warning five minutes prior to a scheduled lights-off event or expiry of a temporary override, the System shall provide two short light level drops as a warning to the affected occupants.

I. BAC Net Communications Interface: Manufacturer shall provide the capability for communications with a BAC Net network. Contractor shall coordinate with the mechanical controls contractor to provide a complete interface to the BAC Net.

J. Load Shed Mode: An automatic load shedding mode shall be available where, when activated through the System, the control unit will reduce its output to a programmable maximum electrical demand load. The System shall not shed more load than required and load shedding priority shall be centrally configurable by light fixture. The individual user shall retain the ability to override System light levels.

K. Emergency Mode: There shall be a mode, when activated through the System, that will immediately adjust lights to full light output and retain that level until the mode is deactivated. This setting shall override all other inputs. The System shall interface with the building emergency monitoring system at a convenient point and not require multiple connections.

L. Addressing: I/O Modules shall be centrally addressable, through the Lighting Control Software. To simplify installation and maintenance, the System shall not require manual recording of addresses for commissioning or reconfiguration.

M. Programmable Task Tuning: Maximum light level programmability shall be available by individual module.

N. Unoccupied State: The System shall provide two states when occupancy status is vacant as per an occupancy sensor: lights turn off or lights adjust to configurable light level.

O. Occupied State: The System shall not isolate occupants by turning off lights that are still required for convenience and safety, such as a hallway path to exit the premises.

P. Firewall Security: System firewall technology shall maintain network security.

Q. Low-Voltage Wiring: Wiring shall be topology independent and not require splicing or termination. Prefabricated, quick connecting wiring shall be utilized. The maximum connected length of wiring shall be no less than 425 meters (1,400 feet) per channel.

R. Reconfigurability: The assignment of individual fixtures to zones shall be centrally configurable by Energy Control Software such that physical rewiring will not be necessary when workspace

reconfiguration is performed. Removal of covers, faceplates, ceiling tiles, etc. shall not be required.

2.2 PANEL HARDWARE

Provide the quantity of factory assembled and tested panels to control the zones indicated on the drawings. Each panel shall consist of:

A. Lighting Control Relay Panels:

1. General

a. Addressing: All lighting control panels shall be individually addressable via Energy Control Software.
b. Communication: All lighting control panels shall communicate via the same prefabricated, quick connecting low-voltage wiring as all other devices.
c. Wiring: Relay control panels shall be interconnected with any other devices on the same wiring loop.
d. Control panels shall have a minimum of 48 relays.

2. Mechanical:

a. Backbox: It shall be shipped separate from the remainder of the equipment to allow for rough in of all conduits. It shall be made of code-gauge steel and contain no knockouts. Labels shall indicate the areas restricted to low-voltage wiring.
b. Chassis: It shall be pre-assembled and contain all relays, electronic and the power supply. The sheet metal chassis shall divide the panel into line voltage and low-voltage compartments.
c. Trim: A surface-mounted trim shall be provided that is painted the manufacturer's standard color. The trim shall contain a window for viewing the status LED's inside the panel. It shall contain a hinged, lockable door that, when open, gives access only to the low-voltage portion of the panel, including the relay manual overrides. A directory card shall be attached to the rear of the door. All doors shall be keyed alike.
d. Provide a multi-voltage power supply transformer that shall provide all power for the panel. A secondary On/Off switch shall be provided to disconnect the control power from the panel for maintenance purposes. Provide internal overcurrent protection.
e. Relays: Each controlled circuit shall be connected through a single pole, single throw mechanically latching relay. A minimum of 48 relays shall be provided for each panel indicated on drawings. If more relays are required, provide additional 48 relay panels to accommodate the loads plus 20% spare.

1) The relay shall contain a single solenoid coil that toggles the contacts to the opposite position with each operation.
2) The relay shall have an actuator device to allow manual actuation of the contacts. Manual actuation shall function both with and without control power present at the relay.
3) The relay shall provide a mechanical means of visual indication of the contact position.
4) The main contacts shall be rated: 20A, 125 VAC Tungsten; 20A, 277 Ballast, 1.0 HP, 125 VAC: 1.5 HP, 250 VAC.
5) Relays shall have a minimum short circuit current rating (SCCR) of 14,000 amps.

6) Dual line and load terminals shall be provided for power wiring that will accept #10 - 14# AWG wires
7) Auxiliary contacts shall be provided for pilot lights and feedback.
8) Mechanical action shall be suitable for zero cross control.
9) Control wires shall terminate in a modular connector that attaches to the chassis electronics.

3. Control Capabilities:

a. Positive Load Feedback: The system shall continuously monitor the position of all loads to provide position indication. It shall alarm all unexpected changes of status and command failures.
b. Selectable Switch Inputs: Each switch input shall be user definable as one of 7 modes.

1) Maintained Input: The load is turned on when it closes, and turned off when it opens.
2) Momentary Input: The load toggles to the opposite state with each closure. No action is taken on opening.
3) Time Delay: The load turns on when the switch closes and remains on for the pre-programmed period of time, after which it automatically turns off.
4) Pulse Accumulator: When connected to an energy meter containing output pulse contacts, this input records the number of pulses received, corresponding to the amount of energy used.
5) External: This input is broadcast over the network. It allows loads in this panel and anywhere in the network to respond to a switch input.
6) Alarm: This input is a momentary input that causes an alarm to be raised at the operator's station and adds an entry into the alarm log each time it is operated.
7) Interlock: This input is used for cleaning crews. It will turn on its associated load. When the next interlocked load is activated, the previous one is turned off. Interlocked loads shall not cancel a time schedule or occupant override.

c. Memory Loss Protection: Programs loaded to automation cards shall be maintained in non-volatile memory, not subject to power outages.
d. Power Fail Recovery: The micro-processor shall operate whenever incoming power is with rated voltage tolerance. When incoming power fails, the micro-processor shall automatically halt program execution in a safe manner. Upon return of power, the micro-processor shall automatically reboot and return the system to normal operation. Any time schedule events that should have occurred during the power outage shall be automatically updated.
e. Real Time Clock: A digital clock shall be provided time of day, day of week and date. Automatic leap year adjustment and selectable daylight savings time adjustments shall be provided.
f. Astronomical Clock: The clock shall automatically calculate sunrise and sunset based on the date and geographic location. Selectable offset of 0 to 120 minutes before and after either sunrise or sunset shall be programmable.
g. Time Scheduling: Schedule capacity shall be large enough to allow the user to program a complete year of events with exact on/off times for relays. In addition, each of the up to 48 loads in each panel shall be able to be uniquely programming with any combination of up to 12 "On" or "Off" events per day. The scheduler shall utilize a 12 month calendar in which repeating schedules for events can be easily redefined in the calendar based scheduling software.
h. Programmable Matrixing. All switch inputs shall be programmable to control any load or combination of loads even if they exist in different switch groups (group overlapping). Any switch input shall be able to control loads anywhere in the

network. All programming changes shall be made via programming. No rewiring or switches shall be required to accomplish these functions.

i. Occupant Warning. Each load shall be programmable to provide a warning blink prior to each scheduled “Off” time. Once the warning has occurred, the occupant may cancel the upcoming “Off” command by operating a local override switch. The load shall remain “On” until expiration of the time out period, or another “Off” command is received. Occupant warning time shall be adjustable between 5 and 30 minutes.

j. Load Sequencing. Multiple loads shall not operate simultaneously, even when triggered by the same switch input or time schedule. Each load operation shall be staggered to reduce the inrush effects on the power system. Sequencing choices shall be 1, 5, 10, 15, 20, 30 or 60 loads per second.

k. Load Priority. To avoid unnecessary confusion to the users, the system shall use a “last action” priority scheme. Time schedules and switch input overrides shall each cancel the action of each other. Momentary and maintained switches operating on the same load shall also cancel each other’s actions.

B. Dimming Panels

1. Mechanical:

a. Panel shall be wall or floor mounted NEMA grade, constructed of sheet steel plates not less than #16 U.S gauge. Contractor shall reinforce wall as required for wall-mounted panels.

b. Panel shall be completely pre-wired by the manufacturer. The contractor shall be required to provide input feed wiring, load wiring, and control wiring. No other wiring or assembly by the contractor shall be permitted.

c. Unless otherwise indicated, panels shall contain branch circuit protection for each dimming module. Branch circuit breakers shall have the following performance characteristics:

1) Be U.L. listed under U.L. 489 as molded case circuit breaker for use on lighting circuits.
2) Contain a visual trip indicator and shall be rated at 10,000 AIC (120V) or 14,000 AIC (277V), unless otherwise noted.
3) Be thermal-magnetic in construction for both overload and dead short protection. The use of fully magnetic breakers shall not be acceptable, even when used in conjunction with individual dimmer thermal cutouts.
4) Be switched duty (SWD) rated so that the loads can be switched off via the breaker.

d. Panel shall be shipped with each dimmer in a BYPASS position via a jumper bar inserted between the input and load terminals. These jumpers shall carry the complete load current and shall be reusable at any time.

e. Panels shall be cooled via free-convection, unaided by fans, and capable of continuous operation to all of these Specifications within an ambient temperature range of 0°C (32°F) to 40°C (104°F).

f. Panel shall provide capability to electronically assign each circuit any zone in the dimming system. Panels using mechanical switches, rewiring, or EPROMS shall not be acceptable.

g. Multiple panels shall be capable of operating in one system, up to a maximum of 32 panels and 768 dimmers. Panels shall have the ability to control individual circuits without controls.

h. For panels fed with normal/emergency feeder, panel shall include electronics to bring all circuits to full on condition upon loss of normal power and subsequent presence of emergency power. Electronics shall switch both the intensity signal

and the on/off signal of each dimmer connected to an emergency circuit between the local and a full-on constant drive supply. This type of emergency may be used with either a normal/emergency generator or a constant hot secondary utility feed where the emergency transfer occurs on the line side (upstream) of the dimming panel and requires only a single normal/emergency feeder.

i. Panels shall have the following additional characteristics:

1) Be designed to prevent any foreign objects from coming into contact with any part of the panel which would be at an elevated temperature, such as the dimmer extrusions or heat fins.
2) Be designed to provide airflow across the heat sink areas and through the dimmer chassis. Panel sections which provide airflow only across heat sinks shall not be mounted one above another in order to allow for adequate heat dissipation.

2. Dimming Modules

a. One type of modular dimming card shall be used for all sources. Systems requiring different types of modules or modular dimming cards shall not be acceptable.
b. A positive air gap relay shall be employed with each dimmer to ensure that the load circuits are open when the “off” function is selected at a control station. These relays need not be integral to the dimming module but must be integral to the dimming panel. Lighting control manufacturer shall provide necessary control interface(s) as part of the control system.
c. All dimmers shall be voltage regulated so that a nominal change in the voltage shall not cause a perceptible change in output voltage.
d. The silicon thyristors used to control the power furnished to the loads shall be both designed and tested to withstand surges, without impairment to performance, of 6000VA, 3000A (equivalent to near lightning strike) as specified by ANSI/IEEE Standard C62.41. Upon request, the manufacturer shall provide a means to demonstrate conformance to this specification using the appropriate surge-generation equipment.
e. Under full-load conditions in a 40°C environment, all silicon thyristors shall operate at minimum 20°C safely margin below the component temperature rating.
f. Filtering shall be provided in each circuit so that the current rise time shall be at least 400 μsec at 50% rated dimmer capacity as measured from 10-90% of the load current waveform at a 90° conduction angle, and at no point rise faster than 30mA/μsec. Manufacturers should note that additional filters may be required to meet this specification. These filters need not be integral to the dimming module, but must be integral to the dimming cabinet.
g. Dimmer output voltage shall be a minimum 95% of input voltage at maximum intensity setting.
h. Minimum and maximum light levels shall be user adjustable for each dimmer.

3. Integral Dimming

a. Preset dimming controls shall be capable of operating at rated capacity without adversely affecting design lifetime.
b. Preset dimming controls shall mount individually in standard 2, 3, or 4-gang U.S wall boxes.
c. Preset dimming controls shall operate in an ambient temperature range of 0°C (32°F) to 40°C (104°F).
d. Preset dimming controls shall incorporate an airgap switch, which shall be accessible without removing faceplate. The airgap switch shall be capable of meeting applicable requirements of UL 20 for airgap switches in incandescent dimmers.

e. Preset dimming controls shall meet IEC 801-2, tested to withstand 15kV electrostatic discharge without damage or loss of memory.
f. Preset dimming controls shall meet ANSI/IEEE Standard C62.41-1980, tested to withstand voltage surges of up to 6000V and current surges up to 200A without damage.
g. Preset dimming controls shall meet the UL 20 limited short circuit test requirement for snap switches.
h. Preset dimming controls shall be voltage regulated.
i. Preset dimming controls shall utilize an LC filtering network to minimize interference with properly installed radio, audio, and video equipment.
j. Minimum light levels shall be user adjustable in order to compensate for different sources and loading.
k. Separate power booster/interface(s) shall increase dimmer capacity. Capacity shall range from 1000W/VA to 30,000W/VA. Quantities and size of each type of power booster shall be provided to control each type of load shown on the load schedule and/or the drawings.

C. Control Devices

1. Momentary Switches and Plates. Low-voltage override switches shall be provided where indicated on the plans.

    a. Switches shall be an individual momentary push button per load group, providing toggle action, “On” only action or “Off” only action as required. Selection of action shall be program settable within the system and changeable at a later date if usage patterns change.
    b. Switches shall be supplied with bi-colored LED pilot light for status. Provide red LED for off and green LED for on. Switch shall flash during the five minute sweep warning.
    c. Up to six switches shall be mountable in a 2” deep single gang box. More switches shall be mountable in multiple gang boxes.
    d. Metallic switchplates and style frames shall be provided. Color combination shall be approved by the Architect prior to fabrication.
    e. Each zone button shall be labeled to clearly identify the zone being controlled.

2. Photo Controller. An exterior photo controller with exterior photocell shall be provided to control exterior zones.

    a. An exterior weatherproof photocell shall be mounted on the roof facing a northerly direction, away from other artificial sources of light.

3. ACLR (Automatic Control Load Relay) Interface to allow control of emergency lighting. Device to comply with UL924 listing requirements.
4. BCELTS (Branch Circuit Emergency Light Transfer Switch). Interface to allow control of phased dimmed emergency lighting. Device to comply with UL1008 requirements
5. Wall Box Dimmers

    a. All devices shall be UL listed specifically for the required loads (i.e., incandescent, fluorescent, low voltage, electronic low voltage). Manufacturer shall provide file card upon request. Universal dimmers shall not be acceptable.
    b. Manufacturer shall maintain ISO 9001 certification. Provide a copy of the certificate as part of the submittal.
    c. All dimmers and switches shall incorporate an air gap which shall be accessible without removing the faceplate. The air gap switch shall be capable of meeting all applicable requirements of UL 20 and UL 1472 for air gap switches in incandescent dimmers.
    d. All dimmers and switches shall provide power failure memory. Should power be interrupted and subsequently returned, the lights will come back on to the same levels set prior to the power interruption. Restoration to some other default level is not acceptable.
    e. Dimmers and switches shall meet ANSI/IEEE Standard C62.41-1980, tested to withstand voltage surges of up to 6000V and current surges of up to 200A without damage.
    f. Dimmers and switches shall meet the UL 20 and UL 1472 limited short circuit test requirement for snap switches.
    g. Dimmer control shall be linear slide. Dimmer shall provide a smooth and continuous Square Law dimming curve.
    h. Dimmer shall be voltage regulated so that +10% variation in line voltage shall cause not more than a +5% variation in load voltage when dimmer is operating at 40V (5% light output).
    i. Dimmers shall utilize a LC filtering network to minimize interference with properly installed radio, audio, and video equipment.
    j. Dimmer control slider shall be captured.

k. Faceplate shall snap on to device with no visible means of attachment. Heat-fins shall not be visible on front of device. At locations with multiple devices, one seamless, multi-gang faceplate shall be provided. Contractor is responsible for coordination of proper back box size and faceplate type.

6. I/O Module (IOM)

a. General:

1) I/O Module shall be the common interface to a driver, sensor, or power pack.
2) Addressing: I/O Module shall be individually addressable via Energy Control Software.
3) Response to Power Failure: In the event of a power failure, I/O Modules connected to light fixtures shall default to the “on” state at full light output.

b. Electrical Specifications

1) Ratings: Shall be low-voltage input.
2) Voltage Compatibility: Universal voltage control capability to 347 VAC maximum.
3) Primary Relay Rating: 347V, 0.8A/277V, 1A/240V, 1.2A/120V, 2.5A
4) Power: Shall supply 12 VDC @ 25 mA power to attached sensor.
5) Control Signal: Shall supply 0 to 10 VDC dimming signal to attached driver or receive control signals from attached sensor.
6) Memory: Retains all system settings in non-volatile memory.

c. Mechanical Specifications

1) Wiring: I/O Module shall not require wiring connections to the System apart from prefabricated, quick connecting low-voltage wiring.

d. Environmental Specifications

1) Operating Temperature Range: 0ºC to +40ºC
2) Relative Humidity: 20% to 90% non-condensing

7. Photo Sensors

a. Interior:

1) A sensor that measures ambient light in a finite area shall be available.
2) The sensor shall measure light from any source in the visible spectrum within at least a 60º cone. It shall measure light between 0 and minimum 75 foot-candles.
3) Electrical: Rating: Maximum 24VDC input voltage.
4) Mounting: The sensor shall be flush mounted on or recessed inside ceiling tile.

b. Exterior:

1) An exterior photo controller with exterior photocell shall be provided to control exterior circuits.
2) An exterior weatherproof photocell shall be mounted on the roof facing a northerly direction, but not into existing sources of light.

3) A low-voltage photo controller shall be mounted adjacent to one of the lighting control panels containing exterior circuits.

8. Occupancy Sensors

a. Sensors using passive infrared, ultrasonic, acoustic, and multi-technology adaptive technology shall be available.
b. Sensor timeouts shall be configurable by System software.
c. Electrical Rating: Maximum 24 VDC input voltage.
d. Mounting: Sensors for mounting on ceilings and walls, including corners, must be available.

9. Four Scene Preset Control

a. Controls shall provide access to 4 preset lighting scenes and off for up to 8 control zones. Control shall be capable of storing an additional 12 preset lighting scenes. Scenes shall be changeable as required. Up to 8 controls may be tied together for more than 8 zones. Controls shall incorporate built-in wide-angle infrared receiver, providing control via a separate a separate infrared wireless remote control transmitter from up to 50 feet away. Preset shall be set via easy-to-use raise/lower switches, one raise and lower switch per zone. The intensity for each zone shall be indicated via an illuminated bargraph Programming of preset scenes shall be accomplished without the use of an ENTER or STORE button. One or more zones may be temporarily overridden without altering the scene values which are stored in memory. Lighting levels shall fade smoothly between scenes at time intervals of 0-59 seconds or 1 to 60 minutes. The fade time shall be separately selectable for each scene. Additionally, control shall provide power failure memory for ten years.
b. Manufacturer shall maintain ISO 9001 certification. Provide a copy of the certificate as part of the submittal.

10. Dimming Accessory Control Options

Provide the following controls for use with the preset control(s) as shown on the drawings and/or described in LIGHTING CONTROL DESCRIPTIONS:

a. Two Scene Entrance Control(s) shall be capable of recalling Scene One plus Off, Scenes 7 and 8, or Scenes 13 and 14. Also can be used as raise/lower partition control and Lockout. All above based on dipswitch settings.
b. Four Scene Control(s) shall be capable of recalling any one of four scenes, master raise/lower, and Off. Control shall provide access to up to 16 scenes.
c. Fine Tuning Control(s) shall allow the temporary override of a particular zone or zones from the preset light level.
d. Infrared Wireless Transmitter(s) shall be capable of recalling any one of four preset scenes and Off. In addition, a master raise/lower shall be provided. The transmitter shall be manufactured by the dimming system manufacturer. The range of the transmitter to any single receiver shall be at least 50 feet. Wall receiver shall incorporate buttons for four scene select, master raise/lower, and off. Ceiling receiver shall provide 360 degree view and an integral LED to provide feedback of proper infrared signal.
e. Special Function Control(s) shall provide the following functions:

1) Sequencing shall allow the user to set up and operate a sequence of 4, 12, or 60 steps. A sequence shall be defined as a series of steps, while a step shall be defined as the recall of a scene. Each step interval is adjustable from 1 second to 60 minutes.

2) Zone lockout shall allow temporary changes without altering light levels preset for each scene.
3) Scene lockout shall lockout the control, maintaining current scene and disabling all buttons on the preset dimming controls.
4) Fade override shall set all fade times to zero.

f. Partition Control(s) shall provide two or four buttons for operating multiple preset units independently or in combination. Each button shall have a corresponding LED to indicate status of a specific partition “door.”
g. Photocell Interface Control(s) shall provide scene selection via daylight photosensor.
h. Equipment Interface(s) shall allow access to preset dimming control(s) via one of the following methods:

1) Isolated momentary/maintained dry contact closures. Where indicated on the drawings, each interface shall provide isolated maintained contact closures rated at 200mA at 30VDC for pilot light status feedback.
2) For use with four scene preset control, RS232 serial communication.
3) For use with four scene preset control, astronomic time clock with 60 events/day and 4 schedules.
4) For use with multiple area-centralized control, DMX512 interface with control of 32 continuous dimming zones via external DMX512 device.

2.3 NETWORK REQUIREMENTS

The lighting control system shall be a distributed intelligence system, consisting of multiple panels that operate on a network.

A. This network shall allow up to 25 lighting control panel(s) to be networked by a shielded dataline control wire. The dataline shall be Belden type or as required by the manufacturer with maximum length of 7500 feet without the use of repeaters. The network shall be self-powered. No external power supply shall be allowed.

B. Independent Operation. Network communications, time of day schedules, and input and load control shall reside in each panel. Each panel shall continue to function independently of other panels if a network failure occurs.

C. Fire Alarm Interface. Provide connection from the fire alarm system to energize specific lighting control zones based on a fire alarm event.

2.4 LIGHTING CONTROL SOFTWARE

A. The Lighting Control Computer (LCC) shall provide the ability to centrally program and monitor loads through application specific software and user-friendly, graphic oriented screens. It shall also provide backup for panelboard/panel data recovery. The MLCC shall be located the Building Operation Office.

1. Computer / touch screen shall be password protected based on user access level.
2. Computer shall be able to access all owner designated screens, programs, etc. Event lighting screens or overrides shall not be accessed from this location.

B. The Lighting Control Touch Screen(s) (LCTS) shall provide the ability to centrally access and monitor loads through application specific software and user friendly, graphic oriented screens. The SLCC shall be located in the Bowl Audio Control Booth, Security Office.

1. Computer shall be password protected based on user access level.
2. Computer shall allow keyboard / mouse operation.

C. Lighting control manufacturer shall provide a software program (windows based) that provides for programming and monitoring of the lighting control system.

1. The software shall be complete with multiple windows, point and click operation, dialog boxes, menu bar, scroll bars, status bar, control buttons, and context sensitive help screens.
2. The software shall be icon driven with each button corresponding to a major function of the lighting control system.
3. Security codes shall be assignable so that different operators shall have different levels of access to the system. Different security levels shall be provided for monitoring, override, programming and administrator access to the system.
4. Configuration dialog boxes shall be provided that allow assignment of descriptions to individual loads and inputs. These descriptions shall be carried over automatically to other screens.
5. A time schedule editor shall be provided which allows a time schedule for multiple loads or repeating events to be viewed, copied, and edited on the same screen and shall be programmed into the 12 month calendar.
6. A monitor and override screen shall be provided that shows each load in the system, its current status and the reason for the last change in operation. From this screen it shall be possible to manually turn loads On and Off.
7. A grouping function shall be provided that allows assigning of a time schedule or switch input to multiple loads located anywhere in the system. Once defined schedules for all loads can be changed by simply changing the group schedule. The software shall automatically update the database in each lighting control panel.

D. The software shall be the product of the lighting control manufacturer and shall provide for customization to meet specific project requirements as specified herein.

E. The manufacturer shall provide the latest version of software available at the time of final acceptance of the system by the owner. This provision shall be at no additional cost to the owner, provided the improved software is fully compatible with the system hardware as installed.

F. Graphics Control Software (GCS). The software package shall be supplied that provides a graphical interface.

1. The software shall operate with the other control software installed. It shall be object oriented with pull down menus and built in help screens. Provide 40 graphic screens.
2. The operator shall be able to individually control any lighting load connected to the system. The operator shall be able to control the load by activating the graphic symbol representing the load or by activating control buttons.
3. Load status shall be indicated by changing the color of the graphics symbol or control button. Green shall indicate the load is On; Gray shall indicate the load is Off.
4. A 12 month calendar in which all games can be programmed for a full year.

G. Graphic Screens. Anticipated graphic screens are as follows:

1. Main Screen (Project Name, Graphics, etc.)
2. Floor Plan Screens

    a. Overall plan of each level. The main screen shall be provided that illustrates the overall building.

        1) When the cursor is moved to a portion of the building corresponding to a detail screen, the screen area shall become highlighted.
        2) Clicking the mouse while within the highlighted area shall automatically bring up the corresponding detail area screen.
        3) Movement between the main screen and subsequent screens shall also be possible by using control buttons.

3. Area plans of each level.
4. Overall zone control – including single button on/off control for entire buildings zones.
5. Egress Lighting Control

    a. Provide override control for egress lighting. Access to the egress lighting zones shall be password protected.
    b. Provide positive verification button which states: “You are about to turn off code required egress lights. Confirm that these areas are not occupied.”

6. Exterior Control Zones

    a. Parking Lot/Site Lighting
    b. Facade Lighting

H. The manufacturer shall provide the latest version of software available at the time of final acceptance of the system by the owner. This provision shall be at no additional cost to the owner, provided the improved software is fully compatible with the system hardware as installed.

2.5 TOUCH SCREENS

A. Hardware Configuration:

1. Touch screens shall be surface or flush mounted. Platform-mounted touch screens are not acceptable.
2. Provide lockable cover for locations subject to public access.

B. Basis of Design: Athena Q-TOUCH5
Features shall include:

1. 5“ capacitive touch display
2. Area, scene, zone-level control of lighting loads
3. Control and integration with Lutron window shades
4. Restricted access controls

2.6 ACCESSORIES

A. Control Devices

1. Momentary Switches and Plates. Low-voltage override switches shall be provided where indicated on the plans.

a. Switches shall be an individual momentary push button per load group, providing toggle action, “On” only action or “Off” only action as required. Selection of action shall be program settable within the system and changeable at a later date, if usage patterns change.
b. Switches shall be supplied with bi-colored LED pilot light for status. Provide red LED for off and green LED for on. Switch shall flash during the five minute sweep warning.
c. Up to six switches shall be mountable in a 2” deep single gang box. More switches shall be mountable in multiple gang boxes.
d. Metallic switchplates and style frames shall be provided. Color combination shall be approved by the Architect prior to fabrication.
e. Each zone button shall be labeled to clearly identify the zone being controlled.

2. Photo Controller. An exterior photo controller with exterior photocell shall be provided to control exterior zones.

a. An exterior weatherproof photocell shall be mounted on the roof facing a northerly direction, away from other artificial sources of light.

3. ACLR (Automatic Control Load Relay) Interface to allow control of emergency lighting. Device to comply with UL924 listing requirements.
4. BCELTS (Branch Circuit Emergency Light Transfer Switch). Interface to allow control of phased dimmed emergency lighting. Device to comply with UL1008 requirements

PART 3 - EXECUTION

3.1 INSTALLATION

A. Lighting Control Panel:

1. Install lighting control panels as indicated, in accordance with manufacturer's written instructions, applicable requirements of NEC standards and NECA's "Standards of Installation" and in compliance with recognized industry practices to ensure that products fulfill requirements.
2. Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturers' published torque tightening values for equipment connectors. Where manufacturer's torque requirements are not indicated, tighten connectors and terminals to comply with torque tightening requirements specified in UL Standards 486A and B.
3. Fasten enclosures firmly to walls and structural surfaces, ensuring that they are permanently and mechanically anchored.
4. Provide engraved, plastic laminate labels for all lighting control panels indicating name, voltage, phase, wire and short circuit rating. Refer to Section 26 05 53 for more information.
5. Provide typed relay directory card upon completion of installation work to match as-built conditions and nomenclature indicated on engineering drawings and submit directories to the Engineer for review prior to mounting in panel.

B. Dimming Panel:

1. Wiring from dimming panel to preset dimming control and accessory controls shall be low voltage Class 2 wiring. All lighting control wiring shall be in an approved raceway specified in Section 26 05 33.
2. Provide accessories as required for construction type indicated on Finish Schedule. Lighting control catalog numbers do not necessarily denote specific mounting accessories for type of wall or surface in which a lighting control may be installed.
3. Provide adequate and sturdy support for each lighting control component. Contractor shall be responsible for verifying weight and mounting method of all lighting controls and furnishing and installing suitable supports. Lighting control mounting assemblies shall comply with all local codes and regulations.
4. Contractor shall be responsible for mounting the lighting controls at the proper depth, and for coordinating the cutout size and shape in wall to ensure that the faceplate covers the cutout entirely. Refer to drawings for location and mounting height of controls.
5. Install lighting controls with vent holes free of air-blocking obstacles.
6. Support elements shall not be mounted to or in contact with ducts or pipes.
7. Mask the lighting controls as necessary to protect the controls during construction.
8. At the completion of construction, clean the face plates and exposed surfaces of all lighting controls, so as to render them free of any material, substance or film foreign to the lighting control. Use soft, non-abrasive cloth and a cleaning solution recommended by the lighting control manufacturer. If the lighting controls are deemed dirty by the Architect at the completion of the project, the Contractor shall clean them at no additional cost to the Owner. Lighting control components whose finishes are damaged shall be replaced at no cost to the Owner.
9. Contractor shall furnish all equipment, labor and materials for the proper installation and system setup of all lighting controls and components as shown on drawings and as specified. System setup includes defining each dimmer's load type, assigning each load to a zone, and setting the control functions. System setup shall take place before building is turned over to Owner, after regular working hours where required.

C. Control Devices:

1. Install lighting control devices in accordance with manufacturer's written instructions, applicable requirements of NEC standards and NECA's "Standards of Installation", and in compliance with recognized industry practices to ensure that products fulfill requirements.
2. Install occupancy sensors and daylight sensors in accordance with manufacturer's written instructions, applicable requirements of NEC standards and NECA's "Standards of Installation", and in compliance with recognized industry practices to ensure that products fulfill requirements. Confirm sensors provide coverage for the spaces in which they are installed and provide additional sensors as required for a completely functional system.

3.2 WIRING INSTALLATION

A. Install wiring between control devices for hard wired connections. All lighting control wiring shall be in an approved raceway specified in Section 26 05 33

B. Coordinate with Division 26 for electrical work, including raceways, electrical boxes and fittings, as necessary to interface installation of lighting control equipment with other work. This Contractor shall route all raceways for lighting control circuits through the lighting control panel, furnish all line and load side conductors, and terminate the line and load side of the lighting control relays. This Contractor shall provide wiring for all remote lighting switches, devices, and their terminations as shown in the construction documents.

1. If the available fault at the panel feeding the branch circuits exceeds the SCCR of the relay, route the branch circuit an additional ten feet between the panel and the lighting control panel.

C. Provide all low-voltage terminations within the lighting control cabinets, to LCD remote control stations, and all required network cabling between lighting control panels.

3.3 GROUNDING

A. Provide equipment grounding connections for lighting control equipment. Tighten connectors to comply with tightening torques specified in UL Standard 486A to assure permanent and effective grounding.

3.4 CLEANING

A. Cleaning: The contractor shall remove all paint spatters and other spots, dirt and debris from the equipment. Clean equipment and devices internally and externally using methods and materials recommended by the manufacturers.

3.5 COMMISSIONING

A. Pre-functional Checklist: Contractor shall perform pre-functional checklist as required for the fundamental commissioning of the lighting control system.

B. Operational Test: This contractor shall provide a complete set of “as wired” drawings of the lighting control system to the owner. These drawings shall be prepared and verified prior to commissioning of the system. Any extra expenses incurred in commissioning the system due to inaccurate or incomplete wiring shall be borne by the electrical contractor.

1. Provide a factory technician to inspect the installation prior to energizing and starting up the lighting control system. This service shall be provided within fourteen days of written notification to the manufacturer that the installation is complete and ready for start-up.
2. The graphic screens shall be functional a minimum of three weeks prior to substantial completion.

C. Commissioning: The contractor shall arrange and pay for the services of factory trained representatives to commission the lighting control system. They shall verify that the contractor has properly installed and interconnected all supplied components. They shall start up all equipment and demonstrate that it meets the requirements of this specification.

D. Programming: Arrange and pay for the services of factory authorized service technicians to install an initial lighting control program into the system.

1. Coordinate operational schedules with the Owner so that a complete schedule is available at the time of commissioning. This Contractor shall be responsible for schedule updates until system is turned over to Owner.
2. Manufacturer shall install the graphics software onto the Lighting Control Computer (LCC) or a designated computer as determined by the owner.

E. Reports: Prepare written reports of tests and observations. Report defective materials and unsatisfactory test results. Record repairs and adjustments made.

3.6 CUSTOMER SUPPORT SERVICES

A. Training: As part of the commissioning procedures, the manufacturer shall train the owner’s representatives in the operation of the system. The manufacturer shall attend all training sessions in person.

1. A minimum of 8 hours of on-site training shall be provided.
2. Training shall occur in a single visit. Training shall include but not be limited to the following:

    a. User group training for manual override locations, functions and sweeps.
    b. Control interface.
    c. Programming owner requested changes.

B. As part of the project, one year following owner turnover the local lighting controls representative shall perform a site evaluation of installed systems. Coordinate the visit with the owner and provide 27 hours of on-site customer support. Customer support is to include:

1. Visual inspection of all lighting control systems and verification of operation per design.
2. Coordination with the owner for the modification and reprogramming of any scenes or time clock functions for any space within the building.
3. Verify occupancy sensor coverage based on user feedback and provided recommended remedy for any deficient spaces. Where the design/shop drawings show coverage but is found to be deficient provide coverage to meet the design intent.

C. Technical Support: The manufacturer shall supply telephone support at no additional cost to the owner for the duration of the warranty period.

D. Spare Components: The manufacturer shall provide the following spare parts to the owner.

1. A minimum of 10 spare relays.
2. A minimum of 5 occupancy sensors.
3. A minimum of 2 daylight sensors.
4. A minimum of 2 spare panel communication cards.
5. A minimum of 2 key pads.

E. Replacement components: The manufacturer shall be able to ship replacement parts within 24 hours for any component that fails during the warranty period.

F. Extended Service Coverage: Maintenance agreements shall be available from the manufacturer to provide service for the system both during and after the warranty period.

END OF SECTION

SECTION 26 22 13 - LOW-VOLTAGE DISTRIBUTION TRANSFORMERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to work of this section.

B. Requirements of the following Division 26 Sections apply to this section.

1. “Electrical Requirements.”

1.2 SUMMARY

A. This section includes general purpose and specialty dry type transformer with winding rated 600V or less, with capacities up to 1000 KVA.

B. Related Sections: The following Division 26 Sections contain requirements that relate to this section:

1. “Electrical Identification” for signs associated with transformer installations.

C. All switchboards, panelboards, switchgears, transformers, disconnect switches, starters, etc., shall be fabricated by same manufacturer throughout the entire project unless specifically noted otherwise.

1.3 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 01 Specification Sections:

1. Product data for each transformer.
2. Transformer physical characteristics, including dimensions, weight, KVA rating, voltage, % impedance, taps, insulation class and sound levels.
3. Wiring diagrams from manufacturer differentiating between manufacturer-installed and field-installed wiring.
4. Transformer no-load losses and efficiency ratings.
5. Product certificates, signed by manufacturer of transformers certifying that their products comply with the specified requirements.
6. Product Test Reports: Certified copies of manufacturer’s design and routine factory tests required by the referenced standards.
7. Shop drawings for each transformer, including dimensional floor plans of electrical rooms, sections, and elevations showing minimum clearances.

1.4 PROJECT RECORD DOCUMENTS

A. Maintain a redline set of contract documents noting all revisions and deviations that are made during the course of the project.

B. Manufacturer shall provide copies of installation, Operation and Maintenance (O&M) procedures to owner in accordance with general requirements of Division 01 and Division 26.

C. Submit O&M data based on factory and field testing, operations and maintenance of specified product.

1.5 QUALITY ASSURANCE

A. Manufacturer's Qualifications: A firm member of NEMA who is regularly engaged in manufacturing components that comply with the requirements of these Specifications and that have been used on at least five projects of similar size and scope as this Project.

B. Field Testing Organization Qualifications: To qualify for acceptance, an independent testing organization must demonstrate, based on evaluation of organization-submitted criteria conforming to ASTM E 699, that it has the experience and capability to conduct satisfactorily the testing indicated.

1.6 REFERENCES

A. Electrical Component Standard: Components and installation shall comply with NFPA 70 "National Electrical Code."

B. ANSI/IEEE C57.96, Distribution and Power Transformers, Guide for Loading Dry-Type appendix to ANSI C57.12 standards.

C. ANSI/IEEE C89.2 – Dry Type Transformers for General Application.

D. IEEE C57.12.01, General Requirements for Dry-Type Distribution and Power Transformers including those with Solid Cast and/or Resin-Encapsulated Windings.

E. IEEE C57.12.91, Test Code for Dry-Type Distribution and Power Transformers

F. 2016 10 CFR Part 431 Energy Conservation Program: Energy Conservation Standards for Distribution Transformers

G. NEMA ST 20, Dry-Type Transformers for General Applications.

H. UL Listing and Labeling: Items provided under this section shall be listed and labeled by UL.

I. Nationally Recognized Testing Laboratory Compliance (NRTL): Items provided under this section shall be NRTL listed and labeled. The term "NRTL" shall be as defined in OSHA Regulation 1910.7.

1.7 DELIVERY, STORAGE AND HANDLING

A. Deliver, store, protect and handle transformer in accordance with the manufacture's recommendations.

B. Transformers shall be located in well-ventilated areas, free from excess humidity, dust, dirt hazardous materials. Transformer shall be protected to prevent moisture from entering enclosure.

C. Transformer shall be shipped with edge and top protection that is adequate to protect the transformer enclosure from common dents and scratches.

1.8 WARRANTY

A. Manufacturer warrants equipment to be free from defects in material and workmanship for 1 year from substantial completion.

PART 2 - PRODUCTS

2.1 GENERAL PURPOSE, DRY-TYPE DOE 2016 TRANSFORMER

A. Comply with NEMA Standard ST 20 "Dry-Type" Transformers for General Applications.

B. Transformers: Factory assembled and tested air cooled units of types specified, having characteristics and ratings as indicated on drawings. Units shall be designed for ratings as indicated in drawings and for 60 Hz service.

C. Cores: Core construction shall be of Grain oriented, non-aging silicon steel with high permeability, low hysteresis and low eddy current losses as need to achieve required efficiency levels. Core laminations shall be tightly assembled and magnetic flux densities shall be kept well below the saturation point.

D. Coils: Continuous windings without splices except for taps.

E. Internal Coil Connections: Brazed or pressure type.

F. Provide high quality copper windings. Wiring compartment and termination shall be accessible by removing enclosure front panels. Three phase transformers shall use one coil per phase in primary and secondary windings.

G. Transformers shall meet the energy efficiency requirements of 2016 10 CFR Part 431. The use of fans to obtain rated KVA or any published rating shall not be permitted for all transformer types.

H. Efficiency at 35% nameplate ratings shall meet or exceed:

1. 15 KVA –97.89%
2. 30 KVA – 98.23%
3. 45 KVA – 98.40%
4. 75 KVA – 98.60%
5. 112.5 KVA – 98.74%
6. 150 KVA – 98.83%
7. 225 KVA – 98.94%
8. 300 KVA – 99.02%
9. 500 KVA – 99.14%
10. 750 KVA – 99.23%

I. Sound Level: Sound levels shall not exceed the following: 150 KVA and below, 50 db; above 150 KVA, 60 db.

J. Transformers shall have the following features and ratings:

1. Enclosures shall meet UL 506 requirements.
2. Enclosure: Indoor, ventilated, drip proof in electric rooms.
3. Enclosure: Outdoor, ventilated raintight, NEMA 3R.
4. Insulation Class: 185°C class for 37½ KVA transformers or smaller; 220°C class for transformers larger than 37½ KVA.
5. Insulation Temperature Rise: 150°C maximum rise above 40°C, for 220°C class insulation; 115°C maximum rise for 185°C class insulation.
6. Taps: For transformer 3KVA and larger, full capacity taps in high-voltage winding as follows:

    a. 3 KVA through 30 KVA: Four 2.5% taps, two above and two below normal voltage.
    b. 30 KVA through 500 KVA: Four 2.5% taps, two above and two below rated normal voltage.
    c. 500 KVA through 1000 KVA: Four 2.5% taps, two above and two below rated normal voltage.

K. Accessories: As follows:

1. Wall-mounting brackets: Manufacturers standard brackets for transformers sized up to 15 KVA where wall mounting is indicated on drawings.
2. Core and coil assemblies 30 KVA and larger to be mounted on rubber vibration isolators on concrete pads.
3. Weather shield kits for ventilated transformers installed outdoors conforming to the requirements of NEMA 250, Type 3R.

2.2 HARMONIC MITIGATING TRANSFORMER

A. Winding Configuration

1. Primary: 480-Volt, 3-phase, 3-ware, delta.
2. Secondary: 208Y/120-Volt, 3-phase, 4-wire output.
3. Harmonic cancellation 3rd, 9th, and other zero sequence harmonics shall be treated in secondary windings through flux cancellation. Fifth (5th) and 7th, harmonics shall be treated on the common primary bus be a phase shift between paired transformers.

B. Harmonic Performance

1. Transformers shall be designed to treat all major harmonics produced by phase-neutral, phase-phase and 3-phase six pulse electronic equipment: 3rd, 5th, 7th, and 9th.
2. Performance Validation: Provide documentation to validate testing of transformer harmonic performance and energy efficiency. Testing to be conducted using three single phase 120V nonlinear load banks with personal computer harmonic profile (100% current total harmonic distortion) at 25% or more of transformer nameplate load level. Test results to be submitted at time of quotation to include transformer efficiency, change in voltage total harmonic distortion between transformer primary and secondary terminals, ratio of 3rd harmonic current in primary delta current profile compared to secondary phase current.
3. Linear Load Efficiency: Transformers shall be DOE 2016 and EPA Energy Star compliant. Performance shall meet or exceed the following: 97.5% for 30 kVA, 97.7% for 45 kVA, 98.0% for 75 kVA, 98.2% for 112.5 kVA, 98.3% for 150 kVA, 98.5% for 225 kVA, 98.6% for 300 kVA, 98.7% for 500 kVA.
4. Nonlinear Load Efficiency: Transformer nonlinear load efficiency shall meet or exceed 97% for all transformers while serving nonlinear loads as described in the Performance Validation Test above totaling between 40% and 60% of the nameplate rating of the transformer.
5. Third (3rd) Harmonic Treatment: 3rd, 9th, and other zero sequence currents shall not be coupled into the transformer primary winding to the extent of delivering a minimum 50 times reduction of the 3rd harmonic in the primary delta current profile compared to that in transformer secondary phase current.
6. Fifth (5th) and 7th Harmonic Treatment: 5th, 7th, 17th, 19th harmonics shall be treated through the primary-to-secondary phase-shift in each transformer as indicated in the Drawings such that these currents subtract at the common bus with those produced by other similar sources.
7. Voltage Distortion: Change in voltage total harmonic distortion between transformer primary and secondary terminals shall be no more than 0.75% per Performance Validation Test.

C. General

1. Harmonic Mitigating Transformers shall be two winding type and be constructed and tested in accordance with ANSI and NEMA standards listed hereinbefore. They shall be designed to withstand for two cycles the maximum fault current which would occur with a bolted fault at the secondary terminals with an infinite bus on the primary side. Each transformer shall comply with the following:

    a. Factory assembled and tested, convection air-cooled units of types and ratings specified.
    b. Frequency: 60 Hertz.
    c. Core: Grain-oriented, non-aging silicon steel, 3-leg, common core.
    d. Coils: Continuous copper windings without splices, except for taps.
    e. Internal Coil Connections: Brazed or pressure type.
    f. Primary Winding: One coil per phase and per core leg; 3-phase, 3-wire input.
    g. Secondary Winding: Multiple coils per phase and per leg; single 3-phase, 4-wire output.
    h. Phase Shift: Primary to secondary to treat targeted harmonics. Zero or 30 degree shift as indicated on the Drawings.
    i. Insulation Class: Class “R”.
    j. Rated Operating Temperature Rise: 130°C above 40°C ambient.
    k. Varnishing: The manufacturing process shall incorporate vacuum pressure impregnation using polyester resin for both primary and secondary windings.

l. Taps: Full capacity taps in primary side windings are as follows:

1) Three (3) through 30 kVA: Two (2) 5% taps; one above and one below rated voltage.
2) Forty-five (45) kVA and Above: Four (4) 2.5% taps, 2 above and 2 below rated voltage.

m. Impedance: Positive and negative sequence: 3.0-4.0% (up to 75 kVA), 3.0-4.8% (112.5-300 kVA). Zero sequence impedance and reactance: 0.95% and 0.3% respectively.
n. Enclosure Type: Indoor, ventilated, drip-proof, NEMA-1 or outdoor, ventilated, rain-proof, NEMA-3R as indicated on the Drawings.
o. Finish: Epoxy powder coating. Enclosure color shall be manufacturer's standard ANSI 61 gray or black.
p. Sound Levels: Pursuant to NEMA ST 20 standard sound levels when factory tested according to IEEE C57.12.91:

1) 10-50 kVA: 45 dB.
2) 51-150 kVA: 50 dB.
3) 151-300 kVA: 55 dB.
4) 301-500 kVA: 60 dB.

q. Electrostatic Shielding: Each winding shall be independently single shielded with a full-width copper electrostatic shield.
r. Neutral conductor rating shall be 200 percent of phase rating.
s. Transformer primary, secondary, and neutral bus pads shall be suitable to accept compression connectors without field modification of lug pads. Provide compression lugs in conductor sizes and quantities as indicated.
t. Provide a copper ground bar for equipment grounding conductor terminations within the transformer enclosure. The ground bar shall be bonded to the transformer enclosure. The ground bar shall accommodate the quantity and size of equipment grounding conductors indicated on the Drawings, the bonding jumper from the transformer "XO", and the grounding electrode conductor without field modification.
u. Provide a copper ground bar for equipment grounding conductor terminations within the transformer enclosure. The ground bar shall be grounded to the transformer enclosure with a bonding jumper. The ground bar shall accommodate the quantity and size of equipment grounding conductors terminated within the transformer as well as the transformer "XO" to enclosure bond without field modification. Space shall be adequate for compression connectors.
v. Each floor-mounted dry type transformer less than 150KVA shall be mounted on Type ND neoprene vibration isolators manufactured by Mason Industries or an Engineer approved equal, to limit transmission of one hundred and twenty (120) cycles per second to ten percent (10%). Vibration isolators shall incorporate bolt holes for bolting to equipment bases, bottom steel plates for bolting to equipment pads, and shall be sized for 3/8" minimum static deflection. External isolators may be omitted on dry type transformers with internal vibration isolation mounts that comply with the vibration transmission limit.

w. Each suspended dry type transformer shall be suspended with Type HD double deflection neoprene vibration isolation hangers manufactured by Mason Industries or an Engineer approved equal, to limit transmission of one hundred and twenty (120) cycles per second to ten percent (10%). Vibration isolators shall incorporate bolt holes for bolting upper and lower hanger rods, and shall be sized for a maximum of 0.4" maximum static deflection. The quantity and rated capacity range of vibration isolators shall be selected based on the transformer and mounting hardware weight.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Arrange equipment to provide adequate spacing for cooling air circulation.

B. Identify transformers in accordance with Division 26 Section "Electrical Identification." Include on label, location of primary overcurrent protection device.

C. Tighten electrical connectors and terminals in accordance with manufacturer's published torque-tightening values. Where manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.2 EQUIPMENT BASES

A. Construct concrete equipment pads as follows:

1. Coordinate size of equipment bases with actual unit sizes provided. Construct base 4-inches high and 2-inches larger in all directions than the overall dimensions of the supported unit.
2. Form concrete pads with framing lumber with form release compounds. Chamfer top edge and corners of pad.
3. Install reinforcing bars, tied to frame, and place anchor bolts and sleeves to facilitate securing units.
4. Place concrete and allow to cure before installation of units. Use Portland Cement conforming to ASTM C 150, 4000 psi compressive strength, and normal weight aggregate.

3.3 STRUCTURAL REVIEW

A. Based on submitted transformers, the Contractor shall submit intended structural support details to the project structural engineer to review to confirm structure is adequate.

3.4 GROUNDING

A. Ground transformers and tighten connections to comply with torque tightening requirements specified in UL Standard 486A.

3.5 FIELD QUALITY CONTROL

A. Inspect for physical damage, broken insulation, tightness of connections, defective wiring, and general condition.

B. Thoroughly clean unit prior to making any tests.

C. Perform insulation-resistance test. Calculate dielectric absorption ratio and polarization index. Make measurements from winding-to-winding and winding-to-ground. Test voltages and minimum resistance shall be in accordance with Table below:

Minimum dc Test Voltage	Recommended Minimum Insulation Resistance in Megohms
1000-Volts	500

D. Verify taps and connect transformer to desired tap, if applicable.

E. Energize primary winding with system voltage. Measure secondary voltage with the secondary load disconnected. Record results.

F. All transformers shall have a disconnecting means on the primary side of the transformer. If the disconnecting means is in a remote location or not within direct line of site of the transformer, the contractor shall provide a permanent phenolic label on the transformer with ¾" black lettering on a white background. The label shall indicate the room name and number indicating where the remote disconnect is located.

3.6 INFRARED INSPECTION (AFTER ENERGIZED)

A. The scan is to include all electrical distribution equipment.

B. All equipment should be energized at normal load levels during an event for at least 1 to 2 hours prior to being scanned.

C. Access covers are to be removed and reinstalled by the electrical Contractor for the testing agency to inspect and scan all electrical junctions, buss, and cable.

D. The IR Scan will be made using a Flir Thermal Imaging Camera. The camera shall provide infrared photos clearly indicating problem areas.

E. All problem areas will be noted as to location, description, and recommended solution by providing a typed report including infrared and digital pictures of all problem areas.

3.7 ADJUSTING AND CLEANING

A. Upon completion of installation, inspect interiors and exteriors of accessible components. Remove paint splatters and other spots, dirt and construction debris. Touch up scratches and mars on finish to match original finish.

B. Adjust transformer taps to provide optimum voltage conditions at utilization equipment.

3.8 PROTECTION

A. Temporary Heating: Apply temporary heat in accordance with manufacturer's recommendations within enclosure of each transformer throughout periods during which equipment is not in a space that is continuously under normal control of temperature and humidity.

END OF SECTION

This page is intentionally left blank.

SECTION 26 24 12 - UTILITY SERVICE CONNECTION CABINETS

PART 1 - GENERAL

1.1 SCOPE

A. The contractor shall furnish and install, where indicated, a free-standing, pad-mounted utility service connection cabinet specified herein, and as shown on the contract drawings.

1.2 REFERENCES

A. The utility service connection cabinet shall be designed, manufactured and tested in accordance with the latest applicable following standards:

1. NEC
2. UL Standard 1773
3. Baltimore Gas and Electric Metering Manual

1.3 SUBMITTALS – FOR REVIEW/APPROVAL

A. The following information shall be submitted to the Engineer:

1. Front view elevation
2. Plan view
3. Single line
4. Conduit entry/exit locations
5. Assembly ratings including:
    a. Short-circuit rating
    b. Voltage
    c. Continuous current
6. Cable terminal sizes
7. Utility metering requirements

1.4 SUBMITTALS – FOR CONSTRUCTION

A. The following information shall be submitted for record purposes:

1. Final as-built drawings and information for items listed in Paragraph 1.04, and shall incorporate all changes made during the manufacturing process
2. Installation information

1.5 QUALIFICATIONS

A. The manufacturer of the assembly shall be the manufacturer of the major components within the assembly.

B. The manufacturer of this equipment shall have produced similar electrical equipment for a minimum period of five (5) years.

C. The manufacturer is to be pre-approved by Baltimore Gas and Electric Company (bge).

1.6 REGULATORY REQUIREMENTS

A. The service connection cabinet shall be listed and labeled by accredited international third party source such as (ETL OR UL) to industry standard 1773.

1.7 DELIVERY, STORAGE AND HANDLING

A. Equipment shall be handled and stored in accordance with manufacturer's instructions. One (1) copy of these instructions shall be included with the equipment at time of shipment.

1.8 OPERATION AND MAINTENANCE MANUALS

A. Equipment operation and maintenance manuals shall be provided with each assembly shipped and shall include instruction leaflets

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. J.M. Gillin Corp.

2.2 RATINGS

A. The assembly shall be rated to withstand mechanical forces exerted during short-circuit conditions when connected directly to a power source having available fault current as provided by the utility.

B. Voltage: 600V

C. Amperage: Rating to be as indicated on the drawings.

2.3 CONSTRUCTION

A. The service connection cabinet shall be a rigid assembly consisting of a base made of die formed 12-gauge galvanized steel channels and frame members bolted together to form a rigid self-supporting structure suitable for pad-mount installation and shall include leveling provisions.

B. The sides and rear shall be covered with removable bolt-on covers. All edges of front covers or hinged front panels shall be formed.

C. The assembly shall be provided with a palette skid that completely seals the bottom of the enclosure to prevent the forks of the lifting means from inadvertently causing shipping damage by entering the bottom of the enclosure.

2.4 BUS

A. All bus bars shall be silver-plated copper or tin-plated aluminum. All phase and neutral bars shall be punched with 9/16” square holes on 2” centers horizontally and 1-3/4” centers vertically. Holes must be square to accept carriage bolt to facilitate one wrench installation.

B. Provide a full capacity neutral bus where a neutral bus is indicated on the drawings.

C. Bus bars to be supported by a minimum of 2 insulator supports every 18” on center.

D. Bus bars shall be sized to accommodate an additional 8-sets of the largest secondary conductor.

2.5 WIRING/TERMINATIONS

A. Compression-type terminals shall be provided for all load terminations and be suitable for copper or aluminum cable rated for 75 degrees C and shall be dual rated to accept (1)#6-750MCM or (2)#6-300MCM per lug

2.6 GROUNDING

A. Meet all NEC requirements for grounding.

B. Meet all grounding requirements as outlines in the bge metering manual.

2.7 UTILITY METERING

A. Pre-approved cabinet is tow have two separate compartments. One for utility use and one for customer use. The utility use compartment will contain the utility meter.

2.8 ENCLOSURES

A. Outdoor NEMA 3R Enclosure

1. Outdoor enclosure shall meet applicable NEMA 3R UL requirements
2. Enclosure shall have a cross checked reinforced roof.
3. The enclosure shall be provided with galvanized pan formed side and rear covers bolted to the frame with tamperproof zinc plated bolts.
4. Doors over utility CT provisions shall have continuous hinges and provisions for padlocking.
5. All exterior and non-galvanized, interior steel surfaces of the service connection cabinet shall be properly cleaned and provided with an oven baked polyester powder coating paint applied electro-statically. Color and finish of the cabinet shall be transformer green.

PART 3 - EXECUTION

3.1 INSTALLATION

A. The Contractors shall install all equipment per the manufacturer's instructions, contract drawings and National Electrical Code.

3.2 GROUNDING

A. Provide equipment grounding connections as indicated herein. Tighten connection to comply with torque tightening requirements specified in UL Standard 486A to assure permanent and effective grounds.

B. Refer to Section 26 05 26 for additional grounding requirements.

3.3 FIELD QUALITY CONTROL

Tests shall conform to International Electrical Testing Association (INETA) Standard ATS, "Acceptance Testing Specifications for Electrical Power Distribution Equipment".

A. Infrared Inspection (After Energized)

1. The scan is to include all electrical distribution equipment.
2. All equipment should be energized at normal load levels during an event for at least 1 to 2 hours prior to being scanned.
3. Access covers are to be removed and reinstalled by the electrical Contractor for the testing agency to inspect and scan all electrical junctions, buss, and cable.
4. The IR Scan will be made using a Flir Thermal Imaging Camera. The camera shall provide infrared photos clearly indicating problem areas.
5. All problem areas will be noted as to location, description, and recommended solution by providing a typed report including infrared and digital pictures of all problem areas.

B. Visual and Mechanical Inspection:

1. Inspect for physical damage and code violations.
2. Inspect for proper alignment, anchorage and grounding.
3. Inspect for proper identification of protective devices and switches.
4. Check tightness of accessible bolted buss joints.
5. Physically test all electrical or mechanical interlocks to assure proper function.
6. Clean interior and insulator surfaces once a month prior to job completion.
7. Inspect for proper operation of space heaters and thermostat settings (if they exist).

C. Electrical Tests:

1. Measure insulation resistance of each buss section phase-to-phase and phase-to-ground.
2. Check panelboards for electrical continuity of circuits and for short circuits.

END OF SECTION

SECTION 26 24 13 - DISTRIBUTION SWITCHBOARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work of this section.

B. Division 26 Basic Electrical Material and Methods sections apply to work specified in this section.

1.2 SUMMARY

A. Provide all switchboards and enclosure work, including cabinets and cutout boxes, as indicated by drawings and schedules, and a specified herein.

B. Wiring Diagrams: Submit wiring diagrams for panelboards showing connections to electrical power feeders and distribution branches.

C. Types of switchboard and enclosures required for the project include the following:

1. Free standing, dead-front, low-voltage fusible distribution switchboards.
2. Free standing, dead-front, low-voltage circuit breaker distribution switchboards.
3. Combination switchboards where noted.
4. Switchboards with integrated metering CT’s.

D. All switchboards, panelboards, switchgears, transformers, disconnect switches, starters, etc., shall be fabricated by same manufacturer throughout the entire project unless specifically noted otherwise.

E. Fuses required in connection with installation of switchboards and enclosures are specified in another Division 26 section.

F. Wires/cables, bus-way, electrical boxes and fittings, and raceways required in conjunction with the installation of switchboards and enclosures are specified in other Division 26 sections.

G. All switchboards are to be provided with main breakers as indicated on the drawings. Main lug only connections are not permitted.

1.3 SUBMITTALS

A. Product Data: Submit manufacturer’s data on switchboards and enclosures.

B. Shop drawings showing dimensions, voltage, phasing, continuous current capacity, and short circuit rating.

C. Submit electrical room plan view drawings at ¼" scale showing all equipment. Provide end and front elevation views of all switchboards showing: disconnects and ratings, buss work, conduit areas, dimensions, cable terminals and cable sizes, recommended housekeeping pad sizes, mounting of equipment supplied and nameplate schedule.

D. The equipment product data, electrical room layouts, coordination study, and short-circuit study shall be submitted together in order to provide proper evaluation.

E. Submittals shall be in accordance with specification section 26 05 00.

1.4 QUALITY ASSURANCE

A. Manufacturer's Qualifications: The manufacturer of this equipment shall be regularly engaged in manufacture of switchboards and enclosures, of types, sizes, and ratings required and have produced similar electrical equipment, for a minimum period of five (5) years. When requested by the Engineer, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.

B. Codes and Standards

1. Electrical Code Compliance: Comply with applicable local code requirements of the authority having jurisdiction and NEC Article 384 as applicable to installation, and construction of electrical and enclosures.
2. UL Compliance: Comply with applicable requirements of UL 50, 869, 486A, 486B, 891, 977 and 1053 pertaining to switchboards, accessories and enclosures. Provide switchboard units which are UL-listed and labeled.
3. Special-Use Markings: Provide switchboards and constructed for special-use, with appropriate UL markings which indicated that they are suitable for special type of use/application.
4. NEMA Compliance: Comply with NEMA Standards Pub/No. 250, "Enclosure for Electrical Equipment (1000-Volts Maximum)", Pub/No. PB 2, "Switchboards", and Pub/No. PB 1.1".

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store switchboards in clean dry space. Protect units from dirt, fumes, water, construction debris and traffic; where necessary to store outdoors, store electrical components above grade and enclose with watertight wrapping.

B. Handle switchboards carefully to prevent internal components damage, breakage, denting, and scoring enclosure finish. Do not install damaged components; replace and return damaged units to equipment manufacturer.

C. The manufacturer of the switchboards shall be capable of delivering equipment to the jobsite with a company-owned truck and driver.

1.6 SEQUENCING AND SCHEDULING

A. Coordinate installation of switchboards and enclosures with installation of wires/cables, electrical boxes and fittings, and raceway work.

PART 2 - PRODUCTS

2.1 DISTRIBUTION SWITCHBOARDS (1200 TO 4000 AMPS)

A. Switchboards shall have an individually-mounted main switch section (if required by drawings) feeding a group-mounted distribution sections. The switchboard shall be front accessible. The contractor shall furnish and completely install all switchboards as shown on the drawings and described in these specifications.

B. The switchboard enclosures shall be a completely self-supporting structure with vertical sections bolted together to form the required arrangement and a rigid assembly. Provide a barrier between each section of switchboard. All sections shall be front aligned and may be rolled, moved or lifted into the installation position and bolted directly to the floor without the addition of floor sills. The structure frame shall be die formed 10-gauge steel with reinforcing corner of 5-bend design. Bolt-on enclosure covers shall be 12-gauge steel. All steels surfaces shall be chemically cleaned prior to painting. Exterior paint color shall be ANSI 61 Light Gray.

1. Switchboards located at exterior locations shall be NEMA 3R with lockable provisions.

C. All buss bars shall be silver-plated copper with a minimum 98% conductivity. They shall be mounted on supports of high impact non-tracking, insulating material, and shall be braced to withstand the mechanical force exerted during short circuit conditions. Provide a minimum 65,000 amperes RMS Symmetrical short circuit bracing or as specified on drawings. A full-length ground buss shall be secured to each vertical section. All lugs shall be UL Listed for use with copper or aluminum cable with ampacity on 75°C conductor temperature ratings.

D. Provide full capacity neutral bus when neutral is shown. Provide a copper ground bus in all vertical sections, minimum ¼” x 3” and be joined in all sections for a continuous bus extending the entire board. All phase busses shall extend through full vertical and horizontal spaces within each section so as to allow additional devices, i.e. fully bussed.

E. Branch-Fusible Switches: Switches feeding non-transformer loads may be of the positive, quick make, quick break type, horsepower rated, over center mechanism and approved for distribution service. The external handle shall be suitable for padlocking in the OFF position and is interlocked with the switch cover to prevent access to the switch interior when the switch is in the ON position - an interlock override release shall be provided. Fusible switch units shall be fully interchangeable without disturbing the adjacent units and shall be capable of withstanding the available let-through short-circuit current and ampacity as shown on the drawings. Units feeding transformer primary windings shall withstand 12x inrush without fuse assistance at 600Vac and be GE HPC or approved equal.

F. Main Fusible Switches: Shall be GE HPC type or approved equal that is 100% rated and can handle 12x inrush of nameplate rating without fuse assistance at 600Vac.

G. Molded Case Circuit Breakers: Provide factory assembled, molded case circuit breakers of frame sizes, characteristics, and ratings including RMS symmetrical interrupting ratings indicated. Select breakers with permanent thermal and instantaneous magnetic trip, and ampere ratings as indicated on the drawings. Construct with overcenter, trip-free, toggle-type operating mechanisms with quick-make, quick-break action and positive handle trip indication. Construct breakers for mounting and operating in any physical position, and operating in ambient temperature of 40°C. Provide breakers with compression or mechanical screw type removable connector lugs, AL/CU rated.

1. Breakers feeding the primary side of a transformer shall accommodate locking provisions.
2. Provide energy reducing maintenance switching with local status indicators for each breaker rated 1,200 amps and greater according to the requirements included in NEC 240.87.

H. Switchboards and all breakers shall be fully rated for available short circuit requirements indicated on drawings.

I. Provide main circuit breakers where shown as 100% rated insulated case type. Provide 480V units with integral zero sequence, solid-state, inverse and fixed time response ground fault relay. Provide all main breakers with adjustable and programmable long time, short time and instantaneous trip features.

J. For switchboards as noted on plans to have integral metering provide rail-mounted CT's of sizes as appropriate for the feeder switch/fuse or breaker with output pre-wired to terminal strips for connection to owner's metering and energy monitoring system. Provide with shorting bars or self-shorting type CT's, metering grade. The communication wiring shall be minimum Cat 5e, un-bonded 4-pair, 24 AWG, Belden 1585B or equal as intended for the purpose. Provide bus tap for voltage connection. CT's shall be precision metering type and for loads up to 400Amps shall have accuracy exceeding ANSI C12.1. Above 400A, CT's shall be rated Class 0.3 at a burden B0.1.

K. Service switchboard: Switchboard shall be UL listed for "service rated."

L. Surge Protective Device (SPD): (Refer to Section 26 43 13 / 26 43 14)

M. Switchboards served from the generator feeding Emergency loads defined by NEC Article 700 and Legally Required Standby loads defined by NEC Article 701 shall have a physical barrier separating the two sources.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine area and conditions under which switchboards and enclosures are to be installed, and notify Engineer in writing of conditions detrimental to proper completion of work. Do not proceed with work until unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF SWITCHBOARDS

A. Install switchboards, and enclosures as indicated, in accordance with manufacturer's written instructions, applicable requirements of NEC standards and in compliance with recognized industry practices to ensure that products fulfill requirements.

B. Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturers' published torque tightening values for equipment connectors. Where manufacturer's torque requirements are not indicated, tighten connectors and terminals to comply with torque tightening requirements specified in UL Standards 486A and B.

C. Fasten enclosures firmly to walls and structural surfaces, ensuring that they are permanently and mechanically anchored.

D. Provide properly wired electrical connections for switchboards, within the enclosures.

E. Provide engraved, plastic laminate labels for all switchboards indicating name, voltage, phase, wire and short circuit rating. In addition, each branch device on the switchboard shall be labeled (engraved). Refer to Section 26 05 53 for more information.

3.3 SWITCHBOARD BASES

A. Construct concrete equipment pads as follows:

1. Coordinate size of equipment bases with actual unit sizes provided. Construct base 4-inches high and 2-inches larger in all directions than the overall dimensions of the support unit. The highest switch shall not exceed 6'-6" above the floor when installed on the pad.
2. Form concrete pads with framing lumber with form release compounds. Chamfer top edge and corners of pad.
3. Install reinforcing bars, tied to frame, and place anchor bolts and sleeves to facilitate securing units.
4. Place concrete and allow to cure before installation of units. Use cement conforming to ASTM C 150, 4,000 psi compressive strength, and normal weight aggregate.

3.4 GROUNDING

A. Provide equipment grounding connections for switchboards enclosures as indicated herein. Tighten connection to comply with torque tightening requirements specified in UL 486A to assure permanent and effective grounds.

B. Refer to Section 26 05 26 for additional grounding requirements.

3.5 FIELD QUALITY CONTROL

Tests shall conform to International Electrical Testing Association (INETA) Standard ATS, “Acceptance Testing Specifications for Electrical Power Distribution Equipment”.

A. Infrared Inspection (After Energized)

1. The scan is to include all electrical switchboards.
2. All equipment should be energized at normal load levels during normal building operation for at least 1 to 2 hours prior to being scanned.
3. Access covers are to be removed and reinstalled by the electrical Contractor for the testing agency to inspect and scan all electrical junctions, buss, and cable.
4. The IR Scan will be made using a Flir Thermal Imaging Camera. The camera shall provide infrared photos clearly indicating problem areas.
5. All problem areas will be noted as to location, description, and recommended solution by providing a typed report including infrared and digital pictures of all problem areas.

B. Switchboards:

1. Visual and Mechanical Inspection:

a. Inspect for physical damage and code violations.
b. Inspect for proper alignment, anchorage and grounding.
c. Inspect for proper identification of protective devices and switches.
d. Check tightness of accessible bolted buss joints.
e. Physically test all electrical or mechanical interlocks to assure proper function.
f. Clean interior and insulator surfaces once a month prior to job completion.
g. Inspect for proper operation of space heaters and thermostat settings (if they exist).

2. Electrical Tests:

a. Measure insulation resistance of each buss section phase-to-phase and phase-to-ground.
b. Check switchboards for electrical continuity of circuits and for short circuits.

3.6 ADJUSTING AND CLEANING

A. Adjust operating mechanisms for free mechanical movement.

B. Touch-up scratched or marred surfaces to match original finishes.

3.7 DEMONSTRATION

A. Subsequent to wire and cable hook-ups, energize switchboards and demonstrate functioning in accordance with requirements. Where necessary, correct malfunctioning units, and then retest to demonstrate compliance.

END OF SECTION

SECTION 26 24 16 - PANELBOARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work of this section.

B. Division 26 Basic Electrical Material and Methods sections apply to work specified in this section.

1.2 SUMMARY

A. Provide all panelboards and enclosure work, including cabinets and cutout boxes, as indicated by drawings and schedules, and a specified herein.

B. Types of panelboards, and enclosures required for the project include the following:

1. Power-distribution panelboards.
2. Lighting and appliance panelboards.

C. All switchboards, panelboards, switchgears, transformers, disconnect switches, starters, etc., shall be fabricated by same manufacturer throughout the entire project unless specifically noted otherwise.

D. Wires/cables, bus-way, electrical boxes and fittings, and raceways required in conjunction with the installation of panelboards, and enclosures are specified in other Division 26 sections.

E. All panelboards are to be provided with main breakers as indicated on the drawings. Main lug only connections are not permitted.

1.3 SUBMITTALS

A. Product Data: Submit manufacturer’s data on panelboards, and enclosures.

B. Wiring Diagrams: Submit wiring diagrams for panelboards showing connections to electrical power feeders and distribution branches.

C. Submit electrical room plan view drawings at ¼” scale showing all equipment, panelboards, disconnects and ratings, buss work, conduit areas, dimensions and mounting of equipment supplied.

D. Shop drawings showing dimensions, voltage, phasing, continuous current capacity, and short circuit rating.

E. The equipment product data, electrical room layouts, coordination study, and short-circuit study shall be submitted together in order to provide proper evaluation.

F. Submittals shall be in accordance with specification section 26 05 00.

1.4 QUALITY ASSURANCE

A. Manufacturer's Qualifications: The manufacturer of this equipment shall be regularly engaged in manufacture of panelboards and enclosures, of types, sizes, and ratings required and have produced similar electrical equipment, for a minimum period of five (5) years. When requested by the Engineer, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.

B. Codes and Standards

1. Electrical Code Compliance: Comply with applicable local code requirements of the authority having jurisdiction and NEC Article 384 as applicable to installation, and construction of electrical panelboards and enclosures.
2. UL Compliance: Comply with applicable requirements of UL 67, "Electric Panelboards", and UL's 50, 869, 486A, 486B, 891, and 1053 pertaining to panelboards, accessories and enclosures. Provide panelboard units which are UL-listed and labeled.
3. Special-Use Markings: Provide panelboards, constructed for special-use, with appropriate UL markings which indicated that they are suitable for special type of use/application.
4. NEMA Compliance: Comply with NEMA Standards Pub/No. 250, "Enclosure for Electrical Equipment (1000-Volts Maximum)", Pub/No. PB 1, "Panelboards", and Pub/No. PB 1.1, "Instructions for Safe Installation, Operation, and Maintenance of Panelboards Rated 600-Volts or Less".

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store panelboards in clean dry space. Protect units from dirt, fumes, water, construction debris and traffic; where necessary to store outdoors, store electrical components above grade and enclose with watertight wrapping.

B. Handle panelboards carefully to prevent internal components damage, breakage, denting, and scoring enclosure finish. Do not install damaged components; replace and return damaged units to equipment manufacturer.

1.6 SEQUENCING AND SCHEDULING

A. Coordinate installation of panelboards and enclosures with installation of wires/cables, electrical boxes and fittings, and raceway work.

PART 2 - PRODUCTS

2.1 PANELBOARDS (1200 AMPS OR LESS)

A. General: Except as otherwise indicated, provide panelboards, enclosures and ancillary components, of types, sizes, and ratings indicated on drawings, which comply with manufacturer's standard materials; with the design and construction in accordance with published product information; equip with proper numbers of unit panelboard devices as required for complete installation.

1. Prefabricated or pre-wired panelboards are not acceptable.

B. Power Distribution Panelboards: Provide dead-front safety type power distribution panelboards as indicated, with panelboards switching and protective devices in quantities, ratings, types, and with arrangement shown; with anti-turn solderless pressure type main lug connectors approved for use with copper conductors. Select unit with feeders connecting at top of panel. Equip with copper buss bars with not less than 98% conductivity, and with full-sized neutral buss; provide suitable lugs on neutral bus for outgoing feeders requiring neutral connection. Provide molded-case main and branch circuit-breaker types for each circuit, with toggle handles that indicated when tripped. Where multiple-pole breakers are indicated, provide with common trip so overload on one pole will trip all poles simultaneously. Where multiple single pole breakers share a common neutral conductor, provide breaker tie bars as required so overload on one pole will trip all poles simultaneously. Provide panelboards with bare un-insulated grounding bars suitable for bolting to enclosures. Select enclosures fabricated by same manufacturers as panelboards, which mate and match properly with panelboards. Employ bolt on breakers that are fully rated for the available short-circuit condition but of not less than 22,000 sym AIC.

C. Lighting and Appliance Panelboards: Provide dead-front safety type lighting and appliance panelboards as indicated, with switching and protective devices in quantities, ratings, types and arrangements shown. Equipped with anti-turn solderless pressure type lug connectors approved for use with copper conductors; construct unit for connecting feeders at top of panel; equip with copper buss bars, full-sized neutral bar, with bolt-in type heavy-duty, quick-make, quick-break, single-pole circuit breakers, with toggle handles that indicate when tripped. Provide suitable lugs on neutral buss for each outgoing feeder required; and provide bare uninsulated grounding bars suitable for bolting to enclosures. Select enclosures fabricated by same manufacturers as panelboards, which mate and match properly with panelboards.

1. Employ breakers that are fully rated for the available short-circuit condition but not less than 10,000 sym AIC at 120/208-Volts; and 14,000 sym AIC at 277/480-Volts.
2. Where multiple single pole breakers share a common neutral conductor, provide breaker tie bars as required so overload on one pole will trip all poles simultaneously.
3. All circuit breakers feeding food service loads or vending machines shall be GFCI type.

D. Panelboard Enclosures: Provide galvanized sheet steel cabinet type enclosures, in sizes and NEMA types as indicated, code-gage, minimum 16-gage thickness. Construct with multiple knockouts and wiring gutters. Provide fronts with adjustable trim clamps, and doors with flush locks and keys, all panelboard enclosures keyed alike, with concealed piano door hinges with door in door swings as indicated. Equip with interior circuit-directory frame, and card with clear plastic covering. Provide baked gray enamel finish over a rust inhibitor coating. Design enclosures for surface mounting. Provide enclosures which are fabricated by same manufacturer as panelboards, which mate and match properly with panelboards to be enclosed.

E. Molded-Case Circuit Breakers: Provide factory-assembled, molded-case circuit breakers of frame sizes, characteristics, and ratings including RMS symmetrical interrupting ratings indicated. Select breakers with permanent thermal and instantaneous magnetic trip, and ampere ratings as indicated on the drawings. Construct with overcenter, trip-free, toggle-type operating mechanisms with quick-make, quick-break action and positive handle trip indication. Construct breakers for mounting and operating in any physical position, and operating in ambient temperature of 40°C. Provide breakers with mechanical screw or compression type removable connector lugs, AL/CU rated. The breakers for 277/480V panelboards shall be industrial grade; breakers that allow or direct particles of combustion resulting from fault conditions out of the breaker are not acceptable, they shall be contained within its casing. For example; GE AE series panelboards with TEY circuit breakers are not acceptable, TED breakers are acceptable.

1. Breakers feeding the primary side of a transformer shall have provisions for locking the breaker on or off.

F. Emergency and Standby Fused Lighting and Appliance Coordination Type Panelboard

(Note: Breaker panelboards may be utilized if manufacturer provides confirmation that system is coordinated to requirements of the AHJ.)

1. Provide dead front safety type fused coordination panelboard(s) with overcurrent and switching devices consisting of series connected branch circuit breakers, lockable in the OFF position and Class CC or Class J fuses in rejection dead-front fuse holders. Provide with copper bussing throughout.
2. Panelboard shall have voltage and current ratings as specified on the drawings including:

    a. 120/208V, 3PH, 4W
    b. 120/240V, 1PH, 3W
    c. 277/480V, 3PH, 4W

3. Panelboard shall have been successfully tested for a short-circuit-current-rating of at least 100,000 amps AC RMS symmetrical at the specified voltage on the drawing.
4. Panelboard shall be selectively coordinated with all upstream overcurrent protective devices in accordance with NEC 700.27, 701.18, 517.26 and 708.54.
5. Refer to project panel schedules for the panelboard circuit configuration, bus capacity, voltage, branch device sizes, enclosure type, mounting, rating, type of mains, etc.
6. Panelboard may require main circuit breaker or provide with Class T Main Fuse Switch ampere ratings is specified on the drawing.
7. Bus bars shall be tin-plated copper with sufficient cross sectional area to meet UL 67 temperature rise requirements. Provide fully rated neutral bar. Lugs on neutral and ground bars shall be sized to accommodate required feeders.
8. All panels fed from the emergency distribution shall accommodate an external Surge Protective Device (SPD). Refer to section 26 43 14.
9. Refer to 26 05 03 for acceptable manufacturers.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine area and conditions under which panelboards and enclosures are to be installed, and notify Engineer in writing of conditions detrimental to proper completion of work. Do not proceed with work until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install panelboards and enclosures as indicated, in accordance with manufacturer's written instructions, applicable requirements of NEC standards and NECA's "Standards of Installation" and in compliance with recognized industry practices to ensure that products fulfill requirements.

B. Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturers' published torque tightening values for equipment connectors. Where manufacturer's torque requirements are not indicated, tighten connectors and terminals to comply with torque tightening requirements specified in UL Standards 486A and B.

C. Fasten enclosures firmly to walls and structural surfaces, ensuring that they are permanently and mechanically anchored.

D. Provide properly wired electrical connections for panelboards within the enclosures.

1. Prefabricated or pre-wired panelboards are not acceptable.

E. Provide engraved, plastic laminate labels for all panelboards indicating name, voltage, phase, wire and short circuit rating. Refer to Section 26 05 53 for more information.

F. At all recessed panel locations, provide three ¾" spare conduits stubbed to the accessible ceiling space for future use.

G. Provide typed panelboards circuit directory card upon completion of installation work to match as-built conditions and nomenclature indicated on engineering drawings and submit directories to the Engineer for review prior to mounting in panelboard.

3.3 GROUNDING

A. Provide equipment grounding connections as indicated herein. Tighten connection to comply with torque tightening requirements specified in UL Standard 486A to assure permanent and effective grounds.

B. Refer to Section 26 05 26 for additional grounding requirements.

3.4 FIELD QUALITY CONTROL

Tests shall conform to International Electrical Testing Association (INETA) Standard ATS, “Acceptance Testing Specifications for Electrical Power Distribution Equipment”.

A. Infrared Inspection (After Energized)

1. The scan is to include all electrical panelboards or bussed distribution equipment.
2. All equipment should be energized at normal load levels during an event for at least 1 to 2 hours prior to being scanned.
3. Access covers are to be removed and reinstalled by the electrical Contractor for the testing agency to inspect and scan all electrical junctions, buss, and cable.
4. The IR Scan will be made using a Flir Thermal Imaging Camera. The camera shall provide infrared photos clearly indicating problem areas.
5. All problem areas will be noted as to location, description, and recommended solution by providing a typed report including infrared and digital pictures of all problem areas.

B. Panelboards:

1. Visual and Mechanical Inspection:

a. Inspect for physical damage and code violations.
b. Inspect for proper alignment, anchorage and grounding.
c. Inspect for proper identification of protective devices and switches.
d. Check tightness of accessible bolted buss joints.
e. Physically test all electrical or mechanical interlocks to assure proper function.
f. Clean interior and insulator surfaces once a month prior to job completion.
g. Inspect for proper operation of space heaters and thermostat settings (if they exist).

2. Electrical Tests:

a. Measure insulation resistance of each buss section phase-to-phase and phase-to-ground.
b. Check panelboards for electrical continuity of circuits and for short circuits.

3.5 ADJUSTING AND CLEANING

A. Adjust operating mechanisms for free mechanical movement.

B. Touch-up scratched or marred surfaces to match original finishes.

3.6 DEMONSTRATION

A. Subsequent to wire and cable hook-ups, energize and demonstrate functioning in accordance with requirements. Where necessary, correct malfunctioning units, and then retest to demonstrate compliance.

END OF SECTION

SECTION 26 25 00 - ENCLOSED BUS ASSEMBLIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work of this section.

B. Division 26 Basic Electrical Material and Methods sections apply to work specified in this section.

1.2 SUMMARY

A. Furnish and install all busway, fittings and accessories as specified herein and as required for proper distribution of power throughout the Project as indicated on the Drawings.

B. All busways shall be fabricated by the same manufacturer as the panelboards and switchboards throughout the entire project.

1.3 SUBMITTALS

A. The following submittal data shall be furnished according to the General Conditions and Section 26 05 00 and shall include, but not be limited to:

1. Busways complete with capacity data, bus data, dimensional data, scaled Shop Drawings indicating bus routing, connector detail, fittings, hangars, etc.
2. Service busways complete with capacity data, bus data, dimensional data, scaled Shop Drawings indicating bus routing, connector detail, fittings, hangars, etc. Service busway including tap boxes Product Data and Shop Drawings shall be submitted to the utility company for approval prior to submitting to the Engineer for review.

1.4 QUALITY ASSURANCE

A. All busway and all components shall be designed, manufactured, tested and installed in accordance with the latest applicable industry standards including the following:

1. Federal Specification W-B-811b
2. ANSI/NEMA BU 1 - Busway
3. NFPA 70 - National Electrical Code (NEC)
4. UL Standard 857 - Busway
5. ANSI/NEMA BU1.1 - General Instruction for Proper Handling, Installation of Busway
6. ANSI/IEEE C37.23 - Metal Enclosed Bus and Calculating Losses

B. All equipment and material to be furnished and installed on this Project shall be UL listed, in accordance with the requirements of the authorities having jurisdiction, and suitable for its intended use on this Project.

1.5 WARRANTY

A. Comply with the requirements of the General Conditions and Section 26 05 00.

PART 2 - PRODUCTS

2.1 RATINGS

A. Except as otherwise indicated on the Drawings, busways shall be three (3) phase, four (4) wires, full neutral for 480Y/277-Volts system with separate half size ground bus bar enclosed within the housing. The entire busway system shall be polarized. In lieu of a separate ground bus bar, the use of the busway housing as an equipment ground system will be acceptable where the impedance of the housing does not exceed that of a separate half size ground bus bar. If the housing is utilized as the grounding path, all system connections of the housing shall be silver plated.

B. Busbars and housing shall be adequately braced to provide the symmetrical short circuit withstand capability in accordance with NEMA Standard but in no case shall the short circuit withstand capability be less than the required symmetrical rms amperes of fault current indicated on the Drawings.

2.2 GENERAL

A. Where shown on the Drawings, furnish and install a busway system of the indicated type and ratings with all necessary fittings, hanging devices and accessories.

B. All plug-in busway shall be provided where indicated on the Drawings in sections not less than *10'-0"*, with a minimum of five (5) plug-in points per section per accessible side. The plug-in sections of bus shall be located vertically to allow full use of the accessible plug-in points utilizing plug-in bus switches sized up to 800 amps. The Contractor shall provide written notice to the Engineer of any field conditions, which may prevent the plug-in bus from being installed as specified herein.

C. Material and installation shall comply with all applicable codes, recommended practices, standards of IEEE, ANSI, NEMA and UL. All components of the busway shall be UL labeled when applicable. Arrangements, details and locations shall be as shown on the Drawings and specified herein.

D. The busway housing shall be of fabricated sheet steel or extruded aluminum providing adequate mechanical protection for the conductors and shall include mounting rails to which hangers may be attached at any point. Hangers are specified in the paragraph titled “Busway Hangers and Supports” hereinafter. Each busway of the specified rating shall be contained in a single housing. Housing shall be finished with two coats of enamel over a rust inhibitor or using an electro deposition paint process.

E. All busbars including neutral and ground busbars shall be either ninety-eight percent (98%) conductivity copper or fifty-five (55%) conductivity aluminum insulated along entire length except at joints and plug outlets by two (2) layers of polyester impregnated glass cloth and two (2) layers of MYLAR to allow for movement due to the differential expansion between bars and housing. Fluid bed epoxy or electrostatically applied epoxy insulation may be used instead of polyester impregnated glass cloth providing the entire system conforms to NEMA Class B (130ºC) requirements. Busbars shall be electroplated at all contact points. Aluminum bus plating process shall be Alstan and shall be so marked or it shall be a silverplate over a copper electroplate. Copper bus joints shall be silverplated. All bus taps for copper and aluminum bus shall be silverplated or tin-plated. Copper bus may be tin plated its entire length in lieu of silver plating at copper bus joints.

F. Busbars shall be sized in accordance with NEMA Standards for nonventilated busways to limit the temperature rise to 55ºC above a 40ºC ambient temperature. Joints in all ratings shall be of the one (1) bolt type with through bolts, which can be checked for tightness without deenergizing the system. It shall be possible to make up a joint from one side in event the busway is installed against a wall or ceiling. The joint shall be so designed as to allow removal of any length without disturbing adjacent lengths. Two (2) Belleville spring washers shall be provided per bolt to maintain maximum positive pressure over the complete contact area.

G. The following table indicates the maximum acceptable voltage drop for both copper and aluminum busbars. The calculations are based on the rated load per 100' for the power factors listed. A horizontal flat wise position is assumed. It should be noted that the maximum voltage drop requirements listed below shall be the basis for all bus bar sizing regardless of the position of the busway shown on the Drawings or required by the service. Voltage drop listed is line-to-line Volts per 100' of bus at 100% rated load and 25ºC ambient.

	ALUMINUM 90% P.F.		COPPER 90% P.F.	
Type Load	Feeder	Plug In	Feeder	Plug In
Distributed	3.69	1.85	2.94	1.47
Concentrated at End	3.69	3.69	2.94	2.94

2.3 EXPANSION SECTIONS

A. Expansion sections shall be furnished as specified herein for all bus runs unless the manufacturer’s written certification that expansion sections will not be required for this specific installation is included in the busway submittals.

1. Expansion sections shall be furnished in the center of any horizontal straight run of 200' or more of copper duct or of 150' or more of aluminum duct. All vertical ducts shall have expansion sections at every 200' of vertical riser. Expansion section shall be used wherever a run of duct crosses an expansion joint or seismic joint in the building. At expansion sections the rigid bars shall be replaced with flexible braid surrounded with glass fiber reinforced thermosetting plastic molding material or glass polyester sheet barriers. Plastic molding material shall be diallyl phthalate, epoxy, phenolic polyester or silicone. No ebony asbestos material is permitted. All shipping bolts in expansion joints shall be removed prior to isolating the bus risers and returned to the Owner prior to energizing the bus.

2.4 BUS SWITCHES

A. On vertical risers, provide plug-in molded case circuit breakers or fusible quick make, quick break-interrupter switches as indicated on the Drawings. Switches shall be externally operated

600-Volt units equipped with appropriate fuse clips. Refer to Section 26 28 16 titled “Enclosed Switches, Fuses and Circuit Breakers” for additional requirements.

B. A metal housing shall completely enclose the bus breaker or switch device. Provide stab shields on plug-in breakers or switches, which protect stabs and ground the plug body to the busway housing before stabs make power contact. Provide a grounding terminal inside each switch body and adequate shielding to prevent access to live parts when the switch cover is open. Provide means for padlocking cover and operating handle in “OFF” position. By removal of one screw the operating handle shall be easily removed from end to side or vice versa so that it will be in the correct position to operate from the floor. All current carrying parts shall be silverplated. Note: All vertical-mounted switching devices shall be mounted so that “Up” is “On” and “Down” is “Off”. A means shall be provided to operate switches from the floor when installed more than six foot six inches (6'-6") above the floor.

C. All plug-in switches shall be arranged so that no more than one (1) plug-in point is utilized for any switch-up through 400 amperes in size. All adjacent plug-in points must be available for additional switches.

2.5 FLEXIBLE BUS CONNECTIONS

A. All busbar connections to equipment mounted on vibration isolation shall be made using flexible braid surrounded with glass fiber reinforced thermosetting plastic molding material. Plastic molding material shall be diallyl phthalate, epoxy, phenolic polyester or silicone. No ebony asbestos insulating material shall be allowed. Bus duct housing shall also have a means of flexible connection.

B. Flexible braid shall be copper with same capacity requirements as rigid bars with silver plated joints.

2.6 BUSWAY END TAP BOX FITTINGS

A. In addition to furnishing and installing the busway system specified hereinbefore and indicated on the drawings, furnish to the Owner two (2) busway end tap boxes for each size feeder or plug-in busway indicated by the Drawings and as specified hereinbefore. The tap boxes shall consist of a set of tap boxes for each bus size on the Project with the same electrical and physical characteristics as specified hereinbefore.

B. The Electrical Subcontractor shall demonstrate to the Owner that the end tap box is compatible with the busway by temporarily installing the fitting on an end of the appropriate busway. Upon completion of the demonstration, the Electrical Subcontractor shall repackage the fittings in a suitable storage facility to prevent physical or moisture damage to the fittings. The fittings storage facility shall be clearly and permanently marked: "4000 Amperes End Tap Box - Male”, as is appropriate for the fitting enclosed.

C. Upon completion of the Project, the properly packed end tap box fittings shall be delivered to the Owner.

D. The busway end tap box fittings shall be manufactured by the same manufacturer furnishing the feeder and plug-in busway.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Provide floor or wall flanges at all fire separations as required, as specified in Section 26 05 00 and as indicated on the Drawings. Coordinate installation of floor flanges and firestop systems with 4-inch-waterproof curbs provided under another division.

B. All busway joints shall be torqued as recommended by the manufacturer. A recheck of torque setting shall be made by the Electrical Subcontractor after the busway has been in service and subjected to varying load conditions. The Electrical Subcontractor shall submit a report of this recheck to the Owner upon completion.

C. All connections to bus breakers or switches shall be made with flexible metal conduit in accordance with the requirement in Section 26 05 33 titled “Raceways and Boxes”. No “hard pipe” connections to bus breakers or switches are allowed. All bus breaker switch connections shall be in place prior to final adjustment and isolation of all vertical bus risers.

D. Three spare fuses of each type and size used in conjunction with circuit protective devices for the bus switches shall be furnished and delivered to the Owner at Substantial Completion. Refer to Section 26 28 16 titled “Enclosed Switches, Fuses and Circuit Breakers” for fuse cabinet requirements.

3.2 BUSWAY HANGERS AND SUPPORTS

A. All horizontal busways throughout the building shall be thoroughly and substantially supported in accordance with the National Electrical Code. Busways may be supported individually with approved hangers or in groups using Unistrut and hangers. Hangers shall not be spaced more than ten feet (10') apart. Additional hangers shall be provided where required by the manufacturer or the local authorities having jurisdiction. Busway shall be attached to the hanger supports. Perforated extension hangers will not be accepted in any part of the Work.

B. All vertical busways shall be substantially supported at each floor line to carry the weight of the busway in a satisfactory manner, with allowance for expansion and contraction. Installation shall comply with the manufacturer's requirements including maximum and minimum spring hangar deflection, expansion section tolerances and torque settings. Coordinate installation of hangers and supports with waterproof curbs provided under another division.

C. Special hangers and supports shall be provided where they may be required because of any peculiarities of construction. Adequate space shall be provided between adjacent busways to provide for maintenance of joints.

D. Hanger rod sizes shall be recommended by the hanger and/or busway manufacturer for the service intended.

3.3 FACTORY TESTING

A. All standard factory tests shall be performed in accordance with the latest version of NEMA and UL Standards.

B. The manufacturer shall provide a certified copy of factory test reports as part of the required submittals.

END OF SECTION

SECTION 26 27 26 - WIRING DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

B. Requirements of the following Division 26 Sections apply to this section.

1.2 SUMMARY

A. This Section includes the following:

1. Receptacles
2. Ground-Fault Circuit-Interrupter Receptacles
3. Plugs
4. Plug Connectors
5. Snap Switches
6. Load Specific Dimmers
7. Wall Plates
8. Occupancy Sensors
9. Floor Boxes

B. Related Sections: The following sections contain requirements that relate to this section:

1. Division 26 Section “Motor Disconnects and Fuses” for devices other than snap switches and plug/receptacle sets used as disconnects for motors.

1.3 SUBMITTALS

A. Product data for each type of product specified.

B. Shop Drawings / Architectural Coordination Requirements:

1. Floor box locations and types indicated on drawings are schematic in nature and are not dimensioned locations. Contractor shall submit shop drawings and product data for final review and comment by the Architect, Owner, and Engineer, to ensure desired aesthetics are achieved.
2. Shop drawings shall include the following detailed information:

a. Placement: Dimensioned floor box placement shown on floor plan with current furniture layer shown.
b. Conduit: Show all conduit size and routing with labels for power, data, AV, etc.
c. Covers: Specific labels or notes to indicate where different cover types and finish are to be used, if applicable.

C. Occupancy Sensors Wired

1. Submit a lighting plan clearly marked by manufacturer identifying product type, locations, orientation and coverage for each sensor.
2. Submit any interconnection diagrams per major subsystems showing proper wiring.

D. Occupancy Sensor Wireless

1. Submit a lighting plan clearly marked by manufacturer identifying product type, locations, orientation and coverage for each sensor.

1.4 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with provisions of the following codes.

1. NFPA 70 “National Electrical Code.”

B. UL and NEMA Compliance: Provide wiring devices which are listed and labeled by UL, Federal Specification and comply with applicable UL and NEMA standards.

1. UL 943

1.5 SEQUENCE AND SCHEDULING

A. Schedule installation of finish plates after the surface upon which they are installed has received final finish.

PART 2 - PRODUCTS

2.1 WIRING DEVICES

A. General: Provide wiring devices, in types, characteristics, grades, colors, and electrical ratings for applications indicated which are UL listed and which comply with NEMA WD 1 and other applicable UL and NEMA standards.

B. Color of Devices: Color of all devices shall be coordinated with the Architect, except special purpose devices shall be black, emergency power system devices which shall be red, corrosion-resistant devices which shall be yellow, or isolated ground devices which shall be orange.

C. Receptacles: As scheduled in Table 1 in Part 3 indicated herein. Comply with UL 498 and NEMA WD 1 and WD 6. Damp and wet location receptacles to be listed as weather resistant. Plug tail devices are not acceptable.

D. Receptacles, Industrial Heavy Duty: Provide pin and sleeve design receptacles conforming to UL 498. Comply with UL 1010 where installed in hazardous locations. Provide features indicated.

E. Receptacles, USB charging type: 2 port, 5 Amp minimum, 5-Volt D.C, WR rated as required.

F. Receptacles, Automatic Receptacle Control required by energy code. Provide receptacles which are marked according to NEC 406.3.

G. Ground-Fault Circuit-Interrupter (GFCI) Receptacles: As scheduled in Table 1 in Part 3 indicated herein: Provide “terminal” or feed-through type ground fault circuit interrupter, as indicated on drawings, with integral heavy-duty NEMA 5-20R duplex receptacles. Provide unit designed for installation in a 2-3/4-inch-deep outlet box without adapter, grounding type, Class A, Group 1 per UL Standard 943 including self-testing.

H. Snap Switches: As scheduled in Table 2 in Part 3 indicated herein.

I. Wall Dimmer: As scheduled in Table 2 in Part 3 indicated herein.

1. Incandescent wall dimmers shall be 120-Volt, solid state type with slide control handle, preset button and semi-flush mounting. Dimmers shall be sized to continuously carry the load they are connected to, the minimum size shall be 1000 watts, and shall be rated larger if indicated on the drawings or required to serve the load.
2. Dimmers indicated on the drawings to serve low-voltage incandescent lamps shall be the same as specified for incandescent lamps and in addition shall be specifically rated for the low-voltage transformer load. Dimmer shall be UL listed for use with low-voltage fixtures.
3. Dimmers indicated to serve fluorescent lamps shall be 120v or 277v, as required for circuit served, solid state type for use with fluorescent dimming ballasts. Control shall be slide handle and dimmer shall be for semi-flush mounting.
4. Dimmers indicated to serve 0-10V loads shall be 120V or 277V, as required for circuit served, solid state type for use with 0-10V ballasts/drivers. Control shall be slide handle and dimmer shall be for semi-flush mounting.
5. All dimmers shall be of the same manufacturer. Faceplate shall be the same color as device plates specified.

J. All exterior weatherproof receptacles located on the roof, receptacles located in elevator pits and machine rooms shall be GFCI type or GFCI protected and have cast metallic “in use” covers.

K. All devices shall be premium specification grade.

2.2 WIRING DEVICE ACCESSORIES

A. Wall Plates: Single and combination, of types, sizes, and with ganging and cutouts as indicated. Provide metal screws for securing plates to devices with screw heads colored to match finish of plates. Provide plates possessing the following additional construction features:

1. Material and Finish: 0.03-inch-thick, type 302 satin finished stainless steel. Plate shall be Hubbell “S” Series or approved equal.
2. Emergency receptacles shall have red cover plates.

B. For all devices installed which are exposed to the weather, moisture or where indicated on the drawings, device plates shall be weatherproof. Device cover plates shall be cast metallic in-use type with gasketing to prevent entrance of moisture when closed.

2.3 OCCUPANCY SENSORS

A. General: Layouts shown on plan drawings are intended to show general control concepts (i.e., wall sensors, ceiling sensors, or switch sensor) for an area. The contractor shall provide sensor coverage of the entire space based on the concept shown, as well as all other devices required (power packs, control wiring, switching, etc.) for a complete and working system. Low-voltage switching to allow local override of the sensors shall be provided at all entries to areas shown as controlled by ceiling or wall-mounted sensors. In areas that require two or more sensors for full coverage, the sensors shall be interconnected together to provide a single switching zone for the entire space, regardless of the number of circuits.

B. Wall switch sensor shall be capable of detection of occupancy up to 300 square feet and gross motion up to 1000 square feet. Wall switch sensors shall accommodate loads from 0 to 800 watts at 120-Volts, 0 to 1200 watts at 277-Volts and shall have 180° coverage capability. All wall switches shall utilize zero crossing circuitry, field deselectable option (automatic – on to manual on).

C. Wall dimmer sensor shall be capable of detection of occupancy up to 300 square feet and gross motion up to 1000 square feet. Wall dimmer sensor shall accommodate loads from incandescent, halogen, MLV, ELV and 0-10V.

D. Ceiling-mounted sensors shall be dual technology (passive infrared and ultrasonic). The sensor shall offer day lighting foot candle adjustment control and be able to accommodate dual level lighting. Sensors shall be immune to false triggering from RFI and EMI.

E. All sensors shall utilize automatically adjustable time delay and sensitivity settings. Settings shall be located on sensor.

F. In the event of failure, a bypass override shall be provided on each sensor. When bypass is utilized, lighting shall remain on constantly or control shall diver to a wall switch until sensor is replaced. This control shall be recessed to prevent tampering.

G. All sensors shall provide an LED as a visual means of indication at all times to verify that motion is being detected during both test and normal operation.

H. Sensors shall have an internal additional isolated relay with normally open, normally closed and common outputs for use with HVAC control, data logging and other control options.

2.4 FLOOR BOXES

A. General Information:

1. Poke Thrus and Cast-in-place floor boxes shall be manufactured with all metal die-cast aluminum construction or steel with die-cast aluminum covers. Devices shall be designed to fit in core hole opening or be cast in place.
2. Covers shall be manufactured with all metal die-cast aluminum or solid metal finish construction. At a minimum, device cover shall be available in the following options; *Black, Gray, Nickel, Brass, Bronze and Brushed Aluminum.*
3. Miscellaneous: Specific device mounting plates and bottom housing assemblies shall be provided for various applications. Contractor shall be load rated for 1000 pounds and provide all components per drawings and/or manufacturer recommendations for a complete solution. Refer to Power and/or Technology drawing details for additional information.

B. Poke-Thru Device (Power / Low Voltage)

1. Application: Elevated slab floor mounted device locations and Modular Furniture Feed floor mounted device locations, as applicable. 6-inch poke-thru shall be used for power only or power/data locations. 8-inch poke-thru shall be used (as applicable) for any locations with AV connectivity.
2. Fire Rating: Poke Through shall be UL listed for use in 2 hour fire rated floors (minimum).
3. Conduit Openings: Poke Thru shall have through floor fitting with a minimum of (1) 3/4-inch conduit for power and pass through channels for low-voltage cabling.
4. Flexible Conduit Feed: Black 2-inch Polytuff flexible conduit shall be provided to extend low-voltage device cabling from floor box knock-out to modular furniture, as applicable.

   Products: Refer to Appendix 1 Floor Box Equipment Schedules for a list of benchmark manufacturer's part numbers.

C. Cast-in-place Furniture Feed Floor Box (Power / Low Voltage)

1. Application: Cast-in-place or slab on grade furniture feed device locations.
2. Compartments: 2-compartment floor box to support power and low-voltage systems such as voice/data.
3. Fire Rating: No Rating.
4. Conduit Openings: Each compartment of floor box shall have knock-outs ranging from 3/4 inch (for power) up to 2 inch (for low-voltage cabling).
5. Flexible Conduit Feed: Black 2-inch Polytuff flexible conduit shall be provided to extend low-voltage device cabling from floor box knock-out to modular furniture, as applicable.

   Products: Refer to Appendix 1 Floor Box Equipment Schedules for a list of benchmark manufacturer's part numbers.

D. Cast-in-place Floor Box (Power / Low Voltage)

1. Application: Cast-in-place or slab on grade floor box locations.
2. Compartments: 4-compartment floor box to support power and low-voltage systems such as voice/data.
3. Fire Rating: No Rating.
4. Conduit Openings: Each compartment of floor box shall have knock-outs ranging from 3/4 inch (for power) up to 1-1/4 inch (for low-voltage cabling).

   Products: Refer to Appendix 1 Floor Box Equipment Schedules for a list of benchmark manufacturer's part numbers.

E. AV Cast-in-place Floor Box (Power / Low Voltage)

1. Application: Cast-in-place or slab on grade floor box locations with AV components.
2. Compartments: 6-compartment floor box to support power and low-voltage systems such as voice/data and audio/visual.
3. Fire Rating: No Rating.
4. Conduit Openings: Each compartment of floor box shall have knock-outs ranging from 3/4 inch (for power) up to 2 inch (for low-voltage cabling).

   Products: Refer to Appendix 1 Floor Box Equipment Schedules for a list of benchmark manufacturer's part numbers.

PART 3 - EXECUTION

3.1 INSTALLATION OF WIRING DEVICES AND ACCESSORIES

A. Install wiring devices and accessories as indicated, in accordance with manufacturer's written instructions, applicable requirements of NEC and in accordance with recognized industry practices to fulfill project requirements.

B. Coordinate with other work, including painting, electrical boxes and wiring installations, as necessary to interface installation of wiring devices with other work.

C. The mounting height of devices is indicated in the legend on the drawings. Where finished walls are exposed concrete block, brick or tile, the height shall be adjusted to allow outlet box for device to be mounted at a joint.

D. Receptacles above countertops shall be installed with major axis horizontal above the backsplash.

E. Install GFCI receptacles or GFCI breakers in all areas as required per NEC 210.8, including but not limited to bathrooms, kitchens, rooftops, outdoors, within 6 feet of a sink, locker rooms, garages, crawl spaces and unfished occupied areas of basements.

F. Install tamper resistance on 15& 20A 120V receptacles in all areas as required per NEC 406.12, including but not limited:

1. Public accessible libraries.
2. Public accessible lobbies and corridors.
3. Public accessible restrooms.

G. Mount all devices within outlet boxes to allow device plates to be in contact with wall on all sides. Align devices with major axis of device parallel to adjacent predominant building feature, i.e., door frames or countertops.

H. Install wall switches on the strike side of doors.

I. Install wiring devices only in electrical boxes which are clean; free from building materials, dirt, and debris.

J. Provide a current carrying conductor, neutral, equipment grounding conductor and an insulated grounding conductor to each isolated ground "IG" receptacle.

K. Install galvanized steel wall plates in unfinished spaces.

L. Install wiring devices after wiring work is completed.

M. Install wall plates after painting work is completed.

N. Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for wiring devices. Where manufacturer's torque requirements are not indicated, tighten connectors and terminal to comply with tightening torque requirements specified in UL Standard 486A. Use properly scaled torque indicating hand tool.

O. Provide hardwire connection to all modular furniture system power entry cables.

3.2 PROTECTION

A. Protect installed components from damage. Replace damaged items prior to final acceptance.

3.3 FIELD QUALITY CONTROL

A. Testing: Prior to energizing circuits, test wiring for electrical continuity, and for short-circuits. Ensure proper polarity of connections is maintained. Subsequent to energizing test wiring devices and demonstrating compliance with requirements, operate each operable device at least six times.

B. Test ground-fault interrupter operation with both local and remote fault simulations in accordance with manufacturer recommendations.

C. TABLE 1

RECEPTACLES

Designation (1)	Current Rating Amps	Voltage Rating	Single/ Duplex	NEMA Config.	Hubbell Catalog #(3)	Notes
-	20	125	Duplex	5-20R	HBL5362	-
-	20	125	Single	5-20R	HBL5361	-
-	20	125	Duplex	5-20R	HBL5362C2	(7)
U (USB)	20	125	Duplex	5-20R	USB20AC5	(6)
IG	20	125	Duplex	5-20R	IG5362	Isolated Ground
WP	20	125	Duplex	5-20R	GFR5362SG/ WP826 (4)	In Use Weather-proof
GFCI	20	125	Duplex	5-20R	GF5362SG	Integral GFCI (2)
-	20	125	Duplex	5-20R	HBL5362SA	Surge Suppression
-	20	125	Duplex	5-20R	HBL8300SGA	Tamperproof

NOTES

1. Letter designations are used where symbols alone do not clearly designate on plans locations where specific receptacle types are used.
2. Protecting downstream receptacles on same circuit is not acceptable.
3. Refer to Section 26 05 03 for additional acceptable manufacturers. Color of device shall be verified with Architect (ivory, gray, white, etc.). All emergency receptacles shall be red.
4. Where required per NEC or local code, provide Hubbell 'WP26E' in-use water-proof cover for two-gang devices.

5. Where receptacles are located in damp or wet locations per article 406 in the National Electric Code, provide receptacles that are listed weather resistant. Use Hubbell HBL5362WR or approved equal receptacles where GFCI is not required at the receptacle location. Use Hubbell GFR5362 or approved equal where GFCI is required at the receptacle location.
6. Provide USB20AC5WR as required where weather resistance is needed.
7. Controlled receptacles shall be marked with power symbol and labeled as “Controlled” as required by the NEC 406.3E.

D. TABLE 2

SNAP SWITCHES

Designation (1)	Typical Application	Load Rating	Voltage Rating (AC)	Poles	Hubbell Catalog #(3)	Notes
S	Control Lights	20A	120/277	1	HBL1221	-
S3	Control Lights	20A	120/277	3-way	HBL1223	-
S4	Control Lights	20A	120/277	4-way	HBL1224	
Sp	Switch and Pilot Light	20A	120/277	1	HBL1221PL	(2)
Sk	Key Switch	20A	120/277	1	HBL1221L	
Swp	Wp Switch and Cover Plate	20A	120/277	1	HBL1281/HBL1750	

NOTES

1. For snap switches, designation is the same as the symbol used on plans for the device. Type of switch is determined from plan context including type of device or circuit being controlled.
2. Pilot light “on” when switch is “on.”
3. Hubbell basis of design. Refer to Section 26 05 03 for additional acceptable manufacturers. Color of device shall be verified with Architect (black, gray, white, etc.).

E. TABLE 3

WALL BOX SENSORS/DIMMER SWITCHES

Load Type (1)	Load Rating	Voltage Rating (AC)	Lutron Part # (2)	Notes
Occ/Vac Sensing 0-10v Dimmer	8A	120/277	MRF2S-8SD010-XX	
Occ/Vac Sensing Switch	8A	120/277	MRF2S-8SS-XX	
Switch	8A	120/277	MRF2S-8S-DV-XX	
CFL/LED Incandescent/MLV Dimmer	150W CFL/LED 600W Inc/MLV	120	MRF2S-6CL-XX	
Incandescent/MLV Dimmer	600W	120	MRF2S-6ND-120-XX	
ELV Dimmer	150W LED 600W ELV	120	MRF2S-6ELV120-XX	

NOTES

1. Provide dimmer wattage size to handle load served. Derate dimmer switch per manufacturer's recommendations where dimmers are ganged together. Provide dimmer model as required based on application, i.e., voltage rating, load, and load type.
2. Lutron basis of design. Refer to Section 26 05 03 for additional acceptable manufacturers. Color of device shall be verified with Architect (black, gray, white, etc.).

END OF SECTION

APPENDIX 1 - FLOOR BOX EQUIPMENT SCHEDULE

NOTES:
1. This specification is intended to be performance based, thus all products listed in the table below are benchmark products. Hubbell's equivalent products are acceptable. Contractor may propose other alternate manufacturers and/or models, but alternates are subject to approval by the Owner, Engineer, and/or Architect.
2. Contractor shall provide complete solution including all necessary components for installation of power and low-voltage systems. Refer to power and low-voltage drawings and/or drawing details and manufacturer recommendations for additional information.

Table 3.1 - Poke-Thru Floor Boxes

Item	Part Name/Description	Manufacturer	Part Numbers
1	4-inch Poke-Thru Device	Legrand / Wiremold	4ATCP2Rxx, 4ATP2Rxx, 4ATCP4Rxx, 4ATP4Rxx, 4PPS
2	4-inch Poke-Thru Center Mount Device Plates	Legrand / Wiremold	4B (blank), 42A (data), 4MAAP (AV)
3	6-inch Poke-Thru Device	Legrand / Wiremold	6ATCFFxx, 6ATC2Pxx, 6AT2Pxx, 6PPS
4	6-inch Poke-Thru Center Mount Device Plates	Legrand / Wiremold	6B (blank), 6ACT8A (data)
5	8-inch Poke-Thru Device	Legrand / Wiremold	8ATC2Pxx, 8AT2Pxx, 8PPS
6	8-inch Poke-Thru Center Mount Device Plates	Legrand / Wiremold	8B (blank), 8ACT8A (data)
7	10-inch Poke-Thru Device	Legrand / Wiremold	10ATCPxx (prewired), 10ATCxx (unwired), 10PPS
8	10-inch Poke-Thru Center Mount Device Plates	Legrand / Wiremold	8B (blank), 8ACT8A (data), 8DEC (AV)

Table 3.2 - Cast-in-Place Furniture Feed Floor Boxes

Item	Part Name/Description	Manufacturer	Part Numbers
1	Cast-in-place Furniture Feed (Power / Low Voltage)	Legrand / Wiremold	EFBFF-OG
2	Furniture Feed Floor Box Cover	Legrand / Wiremold	FPFFTCxx
3	Furniture Feed Floor Box Accessories (Divider, etc.)	Legrand / Wiremold	EFBFF-DIV

Table 3.3 - Cast-in-Place Floor Boxes

Item	Part Name/Description	Manufacturer	Part Numbers
1	Cast-in-place Floor Box (Power / Low Voltage)	Legrand / Wiremold	RFBA Series (RFBA4R30OG, RFBA4C30OG)
2	Floor Box Cover	Legrand / Wiremold	6CTC2xx, 6BTC2xx, FPBTCxx, FPCTCxx
3	Floor Box Accessories (Low-Voltage mounting plates, Divider, etc.)	Legrand / Wiremold	Submit for approval (Refer to drawing details)

Table 3.4 - AV Cast-in-Place Floor Boxes

Item	Part Name/Description	Manufacturer	Part Numbers
1	AV Cast-in-place Floor Box (Power / Low Voltage)	Legrand / Wiremold	EFB8S-OG
2	AV Floor Box Cover	Legrand / Wiremold	EFB6810CTCxx, EFB6810BTCxx

Table 3.4 - AV Cast-in-Place Floor Boxes			
Item	**Part Name/Description**	**Manufacturer**	**Part Numbers**
3	AV Floor Box Accessories (Low-Voltage mounting plates, Divider, etc.)	Legrand / Wiremold	Submit for approval (Refer to drawing details)

Table 3.5 - Floor Boxes for Raised Floors or Wooden Floors			
Item	**Part Name/Description**	**Manufacturer**	**Part Numbers**
1	Recessed Floor Box for Raised Floors (Power / Low Voltage)	Legrand / Wiremold	CRFB Series
2	Floor Box Cover (Raised Floors)	Legrand / Wiremold	CRFBBTCxx, 8CTC2xx, 8CT2xx
3	Floor Box Accessories (Low-Voltage mounting plates, Divider, etc.)	Legrand / Wiremold	Submit for approval (Refer to drawing details)

This page is intentionally left blank.

SECTION 26 27 29 - ELECTRIC VEHICLE CHARGING SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Related Sections include the following:

1.	Section 26 00 10	-	General Requirements
2.	Section 26 24 16	-	Panelboards
3.	Section 26 28 16	-	Enclosed Switches, Fuses and Circuit Breakers
4.	Section 26 43 14	-	Surge Protection Devices

1.2 SUMMARY

A. Furnish and install all Electric Vehicle Charging Systems as specified herein and as indicated on the Drawings.

1.3 REFERENCE STANDARDS

A. Each Electric Vehicle Charging Station and all components shall be designed, manufactured and tested in accordance with the latest applicable industry standards including the following:

1.	UL Standard 991	-	Standard for Tests for Safety Related Controls Employing Solid State Devices
2.	UL Standard 1998	-	Standard for Software in Programmable Components
3.	UL Standard 2231-1	-	Standard for Personnel Protection Systems for Electric Vehicle (EV) Supply Circuits: General Requirements
4.	UL Standard 2251	-	Standard for Plugs, Receptacles and Couplers for Electric Vehicles
5.	UL Standard 2594	-	Standard for Electric Vehicle Supply Equipment
6.	SAE J1772	-	Standard for Electric Vehicle Conductive Charge Coupler
7.	FCC Part 15, Class A	-	Declaration of Conformity
8.	NFPA 70	-	National Electrical Code (NEC)

B. All equipment and material to be furnished and installed on this Project shall be UL or ETL listed, in accordance with the requirements of the authorities having jurisdiction, and suitable for its intended use on this Project.

1.4 SUBMITTALS

A. The following submittal data shall be furnished according to the General Conditions and Section 26 00 10 and shall include, but not be limited to:

1. Electrical Vehicle Charging System complete with physical dimensions, elevations, plan views, Conduit entry location, cable termination sizes, mounting details, schematic diagram, nameplate data, voltage, current and short circuit ratings, connector details, factory test reports, verification of Division 25 BMCS interface, installation details, etc.

2. Schematic diagrams clearly differentiating between manufacturer-installed wiring and field-installed wiring, including communication interconnection between units and wireless communications antenna locations.
3. Manufacturers Field Test Reports.
4. Submit sample service contract for maintenance and service agreement.

B. Refer to Specification Section 26 05 00 for Record Drawings and Operations and Maintenance Manual requirements.

1.5 WARRANTY

A. Comply with the requirements of the General Conditions and Section 26 00 10.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. If it complies with these Specifications, Electric Vehicle Charging Systems manufactured by one of the following will be acceptable:

1. ChargePoint
2. ABB
3. Car Charging Inc.
4. Leviton
5. NRG eVgo
6. SemaConnect

2.2 RATINGS

A. Electrical Input per charger – Level 2

1. Input Power: 7.2 kW
2. Input Voltage: 208V 1-phase, 3-wire
3. Input Current: 30A
4. Input Circuit Breaker: 40A, 2-pole, non-GFCI, dedicated circuit
5. Input Power Connections: 2-phases plus ground
6. Standby Power: 5W

B. Electrical Output per charger – Level 2

1. Output Charging Power 7.2 kW
2. Output Voltage: 208V 1-phase, 3-wire
3. Output Current: 30A
4. Output Charging Connector: SAEJ1772 connector with 18-foot cable.

C. Safety and Operational Ratings

1. Surge Protection: 6kV at 3000A.
2. Operating Temperature: -22°F to 122°F (-30°C to 50°C)
3. Operating Humidity: Up to 95% non-condensing.
4. Enclosure: NEMA 3R

D. Dual Charger Electrical Input – Level 2 with Power Share

1. Input Power: 7.2 kW
2. Input Voltage: 208V 1-phase, 3-wire
3. Input Current: 32A
4. Input Circuit Breaker: (1) 40A, 2-pole, non-GFCI, dedicated circuit
5. Input Power Connections: 2-phases plus ground

E. Dual Charger Electrical Output – Level 2 with Power Share

1. Output Charging Power 7.2 kW
2. Output Voltage: 208V 1-phase, 3-wire
3. Output Current: (1) at 7.2kW, 30A or (2) at 3.8kW, 16A
4. Output Charging Connector: (2) SAEJ1772 connector with 18-foot cable.

2.3 GENERAL

A. The Electric Vehicle Charging System (EVCS) shall consist of two main components, the Electric Vehicle Charge Station (Station) and the Electric Vehicle Network (Network).

B. Electric Vehicle Charge Station

1. The electric vehicle charging station shall be single or dual chargers as shown on the drawings. Dual chargers may include Power Share capabilities. Refer to drawings for details regarding location of components, voltage and current rating of devices and other required details.
2. The station shall be connected to the building grounding system by an equipment grounding conductor installed with the circuit conductors connected from the local service panel to the Electric Vehicle Supply Equipment (EVSE) grounding terminal block.
3. Interface

    a. Card Reader: ISO 15693, 14443
    b. Ground Fault Protection.
    c. Plug Out Detection: Power is terminated per SAEJ1772™ for all Level 2 charging.
    d. Power Measurement: 2% at 5-minute intervals.
    e. Local Area Network: 2.4 GHz 802.15.4 dynamic mesh network.
    f. Wide Area Network: Commercial CDMA cellular data network.

4. Display
5. The station shall have a means to provide digital instructions, and status.

C. Electric Vehicle Network

1. Connectivity

    a. The Electric Vehicle (EV) chargers shall be connected to the network via cellular network interfaces. The network shall include the following features:

        1) 24/7 Driver Assistance.
        2) Station Locations
        3) Trip Mapping
        4) Driver Billing
        5) Driver Notification Services

b. The network shall be compatible with:

1) Remote Management
2) Billing
3) Maintenance
4) On-Demand Software Applications

c. Up to 24 non-gateway electric vehicle charging stations shall communicate to a gateway.
d. Where wireless communications are obstructed, provide network cabling to connect between stations per the manufacturers guidelines.

2. Billing and Payment

a. The stations on the network shall be equipped with integrated RFID card readers that accept network cards and credit cards.
b. The network shall run algorithms to ensure power is delivered only to the authorized driver and only when connected properly.
c. When the charge stops unexpectedly due to a plug-out or a power failure, the system shall alert the driver. The charge shall not resume until the driver reactivated the charge with the integrated RFID card.

3. Detection

a. The Driver Portal shall contain information about Charging Status and Reservations. The Driver Portal shall allow the driver to customize the notifications they receive as either text message or e-mail.

1) The charging status shall inform about:

a) Vehicle not charging.
b) Demand Response
c) Plug Out
d) GFCI Trip
e) Overcurrent Detected

2) The reservation function shall inform about:

a) Pending Reservation Start Time
b) Pending Reservation End Time
c) Station is Unreachable
d) Station requires Maintenance
e) Reservation Violation

b. Ground Fault

1) Integrated ground fault detection shall be standard. It shall have auto retry functionality giving three retry attempts.

c. Overcurrent Detection

1) The charger shall disconnect power to prevent breaker tripping in the upstream service panel. It shall have auto retry functionality giving three retry attempts.

d. Plug-Out

1) The network shall monitor the plug. An algorithm shall sense a plug-out condition and cease power delivery. The driver shall be notified via:

a) Text message to a cell phone

e. Charge Complete

1) The network shall monitor the charge. An algorithm shall sense the charge is complete. Upon completion, the network shall notify the driver.

4. Firmware

a. Firmware shall be upgradeable over the network.

5. Remote Diagnostics and Control

a. The network shall monitor each station in real time. Alarming and maintenance information shall be transmitted to the Station Manager via the network. The Station Manager shall have the ability to clear the alarm after maintenance is finished via the network.

6. Network Interface

a. Cellular network interfaces shall allow for integration with back office business systems.

7. Energy Meter and Smart Grid Compatibility

a. The Energy Meter and Smart Grid interfaces shall enable the driver to make pricing choices based on demand response and time-of-use.

D. Alternate: A three (3) year maintenance and service agreement starting after Substantial Completion shall be offered to provide data hosting, reporting, payment processing, and customer support services. Provide a sample contract for these services.

PART 3 - EXECUTION

3.1 INSTALLATION

A. All installation work shall be performed by a qualified person who is familiar with the installation, construction and operation of the equipment and the hazards involved.

B. Install per manufacturer’s recommendations and contract documents.

C. Install units plumb, level and rigid without distortion.

D. The station shall be floor mounted using the plate/pole assembly, J-Bolts and associated parts per manufactures recommendations.

E. Installation of the Station and Network shall follow the procedure in the published literature.

3.2 ADJUSTMENTS AND CLEANING

A. Remove debris from the electric vehicle charging station and wipe dust and dirt from all components.

B. Repaint marred and scratched surfaces with touch up paint to match original finish.

3.3 FACTORY TESTING

A. All standard factory tests shall be performed in accordance with the latest version of NEMA, UL, and SAE Standards.

3.4 FIELD TESTING

A. Check tightness of all accessible mechanical and electrical connections to assure they are torqued to the minimum acceptable manufacture’s recommendations.

B. Check all installed panels for proper grounding, fastening and alignment.

C. System manufacturer's local representative shall provide startup assistance including:

1. Coordination and direction as necessary for the installation, hookup, interface and operation of the Electric Vehicle Charging System.
2. All required programming and configuration necessary to program each Electric Vehicle Charging System and to allow communications via the communication interface. Provide station initial activation.
3. One (1), four (4) hour, onsite training seminars and hands on training for the Owner's representative and building engineer covering all installation, operation and programming of system functions.

END OF SECTION

SECTION 26 28 16 - ENCLOSED SWITCHES, FUSES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work of this section.

B. Section 26 05 02, “Basic Material and Methods”, applies to work of this section.

1.2 SUMMARY

A. Provide all circuit and motor disconnect switch work including fusing, electrical connections to motors, appliance and mechanical equipment as indicated on the drawings and schedules.

B. Types of circuit and motor disconnect switches in this section include the following:

1. Equipment disconnects.
2. Appliance disconnects.
3. Motor-circuit disconnects.

C. Applications of electrical power connections specified in this section include the following:

1. To resistive heaters.
2. From electrical source to motor starters.
3. From motor starters to motors.
4. To lighting fixtures.
5. To converters, rectifiers, transformers, inverters, rheostats, and similar current adjustment features of equipment.
6. To grounds including earthing connections.
7. To panelboards, contactors, time clocks and similar equipment.
8. Enclosed busway plug-in assemblies.

D. All switchboards, panelboards, transformers, disconnect switches, starters, etc., shall be fabricated by same manufacturer throughout the entire project.

1.3 SUBMITTALS

A. Product Data: Submit manufacturer’s data on circuit and motor disconnect switches, and equipment connectors.

B. Fuse Product Data: For each type of fuse indicated. Include construction details, material, dimensions, descriptions of individual components, and finishes for spare-fuse cabinets. Include the following for each fuse type indicated:

1. Ambient Temperature Adjustment Information: If ratings of fuses have been adjusted to accommodate ambient temperatures, provide list of fuses with adjusted ratings.

    a. For each fuse having adjusted ratings, include location of fuse, original fuse rating, local ambient temperature, and adjusted fuse rating.
    b. Provide manufacturer's technical data on which ambient temperature adjustment calculations are based.

2. Dimensions and manufacturer's technical data on features, performance, electrical characteristics, and ratings.
3. Current-limitation curves for fuses with current-limiting characteristics.
4. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse.
5. Fuse sizes for elevator feeders and elevator disconnect switches.

1.4 QUALITY ASSURANCE

A. All equipment shall be in compliance with codes and standards referenced in Section 26 05 00 titled “Electrical Requirements”.

B. UL Compliance: Comply with requirements of UL 98, “Enclosed and Dead-Front Switches.” Provide circuit and motor disconnect switches which have been UL listed and labeled.

C. Comply with UL Standard 486A, “Wire Connectors and Soldering Lugs for Use with Copper Conductors,” including, but not limited to, tightening of electrical connectors to torque values indicated.

D. NEMA Compliance: Comply with applicable requirements for NEMA Standards Pub/No. KS 1, “Enclosed Switches,” and No. 250, “Enclosures for Electrical Equipment (1000-Volts Maximum).”

E. ANSI Compliance: Comply with applicable requirements of ANSI C97.1, “Low-Voltage Cartridge Fuses 600-Volts or Less.”

F. NEMA Compliance: Comply with NEMA FU1 for cartridge fuses.

1.5 PROJECT CONDITIONS

A. Where ambient temperature to which fuses are directly exposed is less than 40 deg F (5 deg C) or more than 100 deg F (38 deg C), apply manufacturer's ambient temperature adjustment factors to fuse ratings

PART 2 - PRODUCTS

2.1 CIRCUIT AND MOTOR DISCONNECT SWITCHES

A. Furnish and install safety switches as required for motor outlets or other equipment. Switches shall be of size, number of poles, and fused or non-fused, as required for job conditions and the National Electrical Code.

B. Switches shall be equipped with fuse contacts and jaws which ensure positive fuse and jaw contact by means of reinforcing spring clips of other approved means. All current carrying parts shall be silver-plated. Hinges shall be non-current carrying. Switches shall be so designed that they can be locked in either open or closed position.

C. All safety switches shall be NEMA 1 enclosed Type “HD” (heavy duty) quick-make, quick-break, and have interlocking cover with handle that may either be front or side operating with padlocking provisions. Provide NEMA 3R weatherproof enclosures where indicated on the drawings or exposed to exterior or damp locations. Incorporate rejection clips where used with Class “R” fuses.

D. Fusible Switches: Heavy duty switches, with fuses of classes and current ratings indicated on drawings. See Section “2.3” for Fuse specifications. Where current limiting fuses are indicated, provide switches with non-interchangeable feature suitable only for current limiting type fuses.

E. Non-fusible Disconnects: Heavy duty switches of classes and current ratings as indicated on drawings.

F. Double-Throw Switches: Heavy duty switches of classes and current rating as indicated on drawings.

G. Bolted Pressure Switches: Bolted pressure switches conforming to and listed under UL Standard 977; single or double-throw arrangement as indicated. For fusible units provide fuses as indicated on drawings.

H. Molded-Case Circuit Breakers: Provide factory-assembled, molded-Accessories:

1. Electrical Interlocks: Provide number and arrangement of interlock contacts in switches as indicated on drawings or specified elsewhere in specifications.
2. Special Enclosure Material: Provide special enclosure material as follows for switches indicated on drawings to be NEMA 4X:

    a. Stainless Steel Type 316.
    b. Heavy case aluminum.

3. Captive Fuse Pullers: Provide built-in pullers arranged to facilitate fuse removal.

2.2 CONNECTIONS FOR EQUIPMENT

A. General: For each electrical connection indicated provide complete assembly of materials, including but not necessarily limited to, pressure connectors, terminals (lugs), electrical insulating tape, electrical solder, electrical soldering flux, heat-shrinkable insulating tubing, cable ties and solderless wirenuts. All other items and accessories as needed to complete splices and terminations of types indicated.

B. Metal Conduit, Tubing and Fittings:

1. General: Provide metal conduit, tubing and fitting of types, grades, sizes and weights (wall thicknesses) indicated for each type service. Where types and grades are not indicated, provide proper selection as determined by Installer to fulfill wiring requirements and comply with NEC requirements for raceways. Provide products complying with Section 26 05 02 titled “Basic Materials and Methods” and Section 26 05 33 titled “Raceways and Boxes” and in accordance with the following listing of metal conduit, tubing and fittings:

    a. Rigid steel conduit.
    b. Rigid metal conduit fittings.
    c. Electrical metallic tubing.
    d. EMT fittings.
    e. Flexible metal conduit.
    f. Flexible metal conduit fittings.
    g. Liquid-tight flexible metal conduit.
    h. Liquid tight flexible metal conduit fittings.

C. Wires, Cables, and Connectors:

1. General: Provide wires, cables and connectors complying with Division 26 05 02 titled “Basic Materials and Methods” and “Section 26 05 19” titled “Electrical Power Conductors and Cables.”
2. Wires/Cables: Unless otherwise indicated, provide wires/cables (conductors) for electrical connections which match, including sizes and rating, of wires/cables which are supplying electrical power. Provide copper conductors with conductivity of not less than 98% at 20°C (68°F).
3. Connectors and Terminals: Provide electrical connectors and terminals which mate and match, including sizes and ratings, with equipment terminals and are recommended for use by equipment manufacturer for intended applications.
4. Electrical Connection Accessories: Provide electrical insulating tape, heat shrinkable insulating tubing and boots, electrical solder, electrical soldering flux, wirenuts and cable ties as recommended for use by accessories manufacturers for type services indicated.

2.3 FUSES

A. General: Except as otherwise indicated, provide fuses of types, sizes, ratings, and average time-current and peak let-through current characteristics, which comply with manufacturer’s standard design, materials, and constructed in accordance with published product information, and with industry standards and configurations.

B. Class RK1 dual element time-delay fuses: Provide UL Class RK1 current limiting time-delay fuses rated 600-Volts, (250-Volts where specified), 60 Hz, with 200,000 RMS symmetrical interrupting current rating for protecting circuit breakers, motors and panelboards.

C. Class RK5 dual element time-delay fuses: Provide UL Class RK5 current limiting time-delay fuses rated 600-Volts, (250-Volts where specified), 60 Hz, with 200,000 RMS symmetrical interrupting current rating for protecting circuit breakers, motors, and transformers.

D. Class L time-delay fuses: Provide UL Class L time-delay fuses rated 600-Volts, 60 Hz, with 200,000 RMS symmetrical interrupting current rating.

E. Class J dual element time-delay fuses: Provide UL Class J time-delay fuses rated 600-Volts, 60 Hz, with 300,000 RMS symmetrical interrupting current rating.

2.4 SPARE-FUSE CABINET

A. Characteristics: Wall-mounted NEMA-1 steel unit with full-length, recessed piano-hinged door and key-coded cam lock and pull.

1. Size: Adequate for storage of spare fuses specified in Section 3.3 with 15 percent spare capacity minimum.
2. Finish: Gray, baked enamel.
3. Provide engraved, plastic laminate label “Spare Fuses” for cabinet. Refer to Section 26 05 53 for more information.
4. Fuse Pullers: For each size of fuse, where applicable and available, from fuse manufacturer.

PART 3 - EXECUTION

3.1 INSTALLATION OF CIRCUIT AND MOTOR DISCONNECT SWITCHES

A. Install circuit and motor disconnect switches as indicated, complying with manufacturer’s written instructions, applicable requirements of NEC, NEMA, and NECA’s “Standard of Installation,” and in accordance with recognized industry practices.

B. Coordinate circuit and motor disconnect switch installation work with electrical raceway and cable work, as necessary for proper interface.

C. Install disconnect switches for use with motor-driven appliances, and motors and controllers within sight of controller position unless otherwise indicated. For all disconnecting means located remote from the motor controller (starter or variable frequency drive), contractor to provide disconnect with auxiliary contacts, contacts and control wiring back to motor controller.

D. Provide NEMA 3R disconnect switches for all exterior locations and any location subject to moisture.

3.2 INSTALLATION OF EQUIPMENT CONNECTIONS

A. Install electrical connections in accordance with equipment manufacturer’s written instructions and with recognized industry practices, and complying with applicable requirements of UL, NEC and NECA’s “Standard of installation” to ensure that products fulfill requirements.

B. Coordinate with other work, including wires/cables, raceway and equipment installation, as necessary to properly interface installation of electrical connections for equipment with other work.

C. Connect electrical power supply conductors to equipment conductors in accordance with equipment manufacturer’s written instructions and wiring diagrams. Mate and match conductors of electrical connections for proper interface between electrical power supplies and installed equipment.

D. Cover splices with electrical insulating material equivalent to, or of greater insulation resistivity rating, than electrical insulation rating of those conductors being spliced.

E. Prepare cables and wires, by cutting and stripping covering armor, jacket, and insulation properly to ensure uniform and neat appearance where cables and wires and terminated. Exercise care to avoid cutting through tapes which will remain on conductors. Also avoid “nicking” copper conductors while skinning wire.

F. Trim cables and wires as short as practicable and arrange routing to facilitate inspection, testing and maintenance.

G. Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturers published torque tightening values for equipment connectors. Accomplish tightening by utilizing proper torque tools, including torque screwdriver, beam-type torque wrench, and ratchet wrench with adjustable torque settings. Where manufacturer’s torque requirements are not available, tighten connectors and terminals to comply with torque values contained in UL 486A.

H. Provide PVC-coated conduit and fittings for highly-corrosive atmospheres.

I. Provide flexible conduit for motor connections, and other electrical equipment connections, where subject to movement and vibration.

J. Provide liquid-tight flexible conduit for connection of motors and other electrical equipment where subject to movement and vibration, and also where connections are subjected to one or more of the following conditions:

1. Exterior location.
2. Moist of humid atmosphere where condensation can be expected to accumulate.
3. Corrosive atmosphere.
4. Water spray.
5. Dripping oil, grease, or water.

K. Fasten identification markers to each electrical power supply wire/cable conductor which indicates their voltage, phase and feeder number in accordance with Division 26 section titled “Electrical Identification.” Affix markers on each terminal conductor, as close as possible to the point of connection.

L. Provide flexible metal conduit or Type “S” rubber cords, pigtails, caps, etc., as required to constitute an operating system. All flexible cords shall have grounding conductors. Ground all equipment. See Section 26 05 26 titled “Grounding and Bonding” for additional requirements.

M. Prior to roughing-in, refer to all equipment manufacturer’s shop drawings for details of equipment connections. Provide receptacles as required to match the cord caps on the equipment furnished. Provide either direct wiring or receptacles for final connection to equipment as required for the particular equipment furnished regardless of the type of outlet shown on the plans.

3.3 INSTALLATION OF FUSES

A. Install fuses as indicated, in accordance with manufacturer’s written instructions and with recognized industry practices to ensure that protective devices comply with requirements. Comply with NEC and NEMA standards for installation of fuses.

B. Coordinate work including electrical wiring, as necessary, to interface installation of fuses with other trades.

C. Install fuses in fused switches.

D. Provide spare fuse cabinet located in each main electrical room. Provide spare fuse of size and type for every five (5) fuses installed. A minimum of three (3) spare fuses shall be provided for each size installed.

3.4 GROUNDING

A. Provide equipment grounding connections, sufficiently tight to assure a permanent and effective ground for electrical disconnect switches.

3.5 FIELD QUALITY CONTROL

A. Testing: Subsequent to completion of installation of electrical disconnect switches, energize circuits and demonstrate capability and compliance with requirements. Except as otherwise indicated, do not test switches by operating them under load. However, demonstrate switch operation through six opening/closing cycles with circuit unloaded. Open each switch enclosure for inspection of interior, mechanical and electrical connections, fuse installation, and for verification of type and rating of fuses installed. Correct deficiencies then retest to demonstrate compliance. Remove and replace defective units with new units and retest.

END OF SECTION

This page is intentionally left blank.

SECTION 26 32 13 - DIESEL-ENGINE DRIVEN GENERATOR SETS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provision of Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work of this section.

B. Division 26 Basic Electrical Materials and Methods Section 26 05 02 apply to work specified in this section.

C. Division 26 Automatic Transfer Switches Section 26 36 23 to be coordinated with work specified in this section.

1.2 SUMMARY

A. Extent of diesel generator set work is indicated by drawings and is hereby defined to include, but not by way of limitation, diesel engine, electrical generator, engine starting system including batteries, instrument control panel, transfer switches, fuel tanks, annunciator panel, exhaust silencer, wall thimble, and accessories.

B. Refer to Division 3 sections for concrete and grout work required in connection with pads for engine-driven generator set work of this section.

C. Refer to Division 23 sections for fuel tank piping and associated accessories required for installation of diesel engine-generator unit.

D. All unit (skid) mounted fuel tank piping and accessories required are work of this section.

E. All generator work shall be coordinated with piping, ducting, and exhaust requirements.

1.3 SUBMITTALS

A. Product Data: Submit manufacturer’s data on diesel engine-driven generator sets and components. Include manufacturer’s standard product warranty, for duration of not less than two-years from substantial completion, for replacement of materials and equipment used in diesel generator systems.

B. Shop Drawings: The Contractor shall submit copies of pertinent drawings and schematic diagrams for approval and shall include the following:

1. Engine generator set including plans and elevations or riser views clearly indicating entrance points for each of the interconnections required.
2. Slip-over steel housing showing all pertinent dimensions and details.
3. Engine generator/exciter control cubicle.
4. Fuel consumption rate curves at various loads, ventilation and combustion CFM requirements.
5. Generator power delivered calculation at project elevation.
6. Exhaust muffler and vibration isolators.

7. Battery charger, battery, and battery rack.
8. Fuel tank connection points.
9. Automatic load transfer switch.
10. Legends for all devices on all diagrams.
11. A complete ½" = 1'-0" scaled site specific plans and sections showing the exact generator and transfer switch system layout including all components and accessories being provided or required for operation as specified herein coordinated with Architectural, Structural, Mechanical, Plumbing and other plans, showing operational and maintenance clearance. Include in place, receptacles, lighting fixtures, and other items pertinent to the complete installation.
12. Generator mounted circuit breaker(s).

C. Wiring Diagrams: Submit wiring diagrams for diesel engine-driven generator unit showing connections to electrical power panels, feeders, automatic transfer switches, and ancillary equipment. Differentiate between portions of wiring that are manufacturer installed and portions that are field installed.

D. Agreement to Maintain: Prior to time of final acceptance, the Installer shall submit an agreement for continued service and maintenance of diesel engine-driven generator sets, for Owner's possible acceptance. Offer terms and conditions for furnishing parts and providing continued testing and servicing, including replacement of materials and equipment, for one-year period with option for renewal of Agreement by Owner.

E. Certifications: Provide diesel engine-drive generator sets certified test record of the following final production testing:

1. Single-step load pickup.
2. Transient and steady-state governing.
3. Safety shutdown device testing.
4. Voltage regulation.
5. Rated power.
6. Maximum power.

F. Provide a letter indicating the manufacturer has reviewed the installation conditions (maintenance clearances, combustion air intake and radiator discharge clearances, etc.) and confirm that the generator can deliver the 100% specified rated output capacity as shown on the shop drawing. Not submitting the letter will be cause for rejection of the submittal.

G. Electronic PDF to include bookmarks to each section of submittal requirements.

1.4 QUALITY ASSURANCE

A. Manufacturer's qualifications: Firms regularly engaged in manufacture of diesel engine-driven generator units and ancillary equipment, of types, ratings and characteristics required, whose products have been in satisfactory use in similar service for not less than 5 years. Manufacturer shall be certified to ISO 9001.

B. Installer's Qualifications: Firms with at least 5 years of successful installation experience on projects with diesel engine-driven generator units similar to that required for this project.

1. Agreement to Maintain: Engage Installer who is willing to execute with the Owner, required agreement for continued maintenance of diesel engine-driven generator units.

C. Generator Supplier Qualifications: Generator supplier shall be factory-authorized distributor nearest to the project location for the system being provided. There shall be a distributor service location for the generator manufacturer within a driving distance of 200 miles. Generator supplier shall certify that they employ at least two technicians who have attended all factory service schools. Supplier shall certify that they offer 24-hour, 7-day field service and maintain the manufacturer's recommended parts inventory on all field service vehicles, as well as a complete recommended service parts stock at their location nearest the project.

D. Codes and Standards:

1. Electrical Codes Compliance: Comply with applicable local code requirements of the authority having jurisdiction and NEC Articles 700, 701, and 702 pertaining to construction and installation of emergency and standby systems.
2. Diesel generators shall be listed in accordance with UL 2200.
3. NFPA Compliance: Comply with applicable requirements of NFPA 37, "Installation and Use of Stationary Combustion Engines and Gas Turbines", NFPA 101, "Code for Safety to Life from Fire in Buildings and Structures", and NFPA 110, "Standards for Emergency and Standby Power Systems".
4. UL Compliance: Comply with applicable requirements of UL 1008, "Automatic Transfer Switches," UL 486A, "Wire Connectors and Soldering Lugs for Use with Copper Conductors," UL 486B, "Wire Connectors for Use with Aluminum Conductors," and UL 6200 "Standard of Controllers for Use in Power Production."
5. ANSI/NEMA Compliance: Comply with applicable requirements of ANSI/NEMA MG 1 "Motors and Generators," and MG 2, "Safety and Use of Electric Motors and Generators".

E. NEMA Compliance: Comply with applicable requirements of NEMA's Standard Pub No. 250, "Enclosures for Electrical Equipment (1000-Volts Maximum)."

F. IEEE Compliance: Comply with applicable portions of IEEE Standard 446, "IEEE Recommended Practices for Emergency and Standby Power Systems for Industrial and Commercial Applications."

1.5 DELIVERY, STORAGE AND HANDLING

A. Deliver diesel engine-driven generator properly packaged and mounted on pallets, or skids to facilitate handling of heavy items. Utilize factory-fabricated type containers or wrappings for engine-generator and components which protect equipment from damage.

B. Store diesel engine-driven generator equipment in original packaging and protect from weather and construction traffic. Wherever possible, store indoors; where necessary to store outdoors, store above grade and enclose with watertight wrapping.

C. Handle diesel engine-driven generator equipment carefully to prevent physical damage to equipment and components. Do not install damaged equipment; remove from site and replace damaged equipment with new.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Performance:

1. Standby kw Refer to drawings
2. Power factor 0.8
3. Speed 1,800 RPM
4. Generator output voltage 277/480-Volt, 3-phase, 4-wire, 60Hz.
5. Units shall be certified by the manufacturer to provide the rated kw at project altitude and 100 degree Fahrenheit ambient temperature.
6. It is intended that all products specified herein be of standard ratings, therefore the kw and kVA ratings, ampere ratings, withstand and closing ratings, etc., shall be the manufacturer's next larger size or rating when the specifications cannot be exactly met.
7. In a standby power capacity, the unit shall be capable of continuous service at rated output for the duration of any utility power failure. The engine and generator shall be the product of a single manufacturer; and that manufacturer and its authorized dealer shall have the responsibility to provide the diesel engine/generator set and its accessories which will meet the specified output at the required altitude and ambient temperature. It shall be a new factory assembled and tested set. It is the intent and purpose of these specifications to also secure for the Owner, the necessary controls and accessories to the extent that this equipment, in conjunction with the diesel/engine/generator set, will comprise a complete operating package unit.
8. Rating of the diesel engine/generator set shall be based on operation of the set when equipped with all necessary operating accessories, such as radiator fan, air cleaners, lubrication oil pump, fuel transfer pump, fuel injection pump, jacket water pump, governor, charging generator, alternating current generator, and exciter regulator. These ratings must be substantiated by manufacturer's standard published curves and test data. Special ratings or maximum ratings are not acceptable.
9. Voltage regulation shall be +/-1.0 percent of rate voltage for any constant load between no load and rated load.
10. Frequency regulation shall be +/-0.5 percent from steady state no load to steady state rated load.
11. Total Harmonic distortion: The sum of AC voltage waveform harmonics, from non-load to full linear load, shall not exceed 5% of rated voltage (L-N, L-L, L-L-L) and no single harmonic shall exceed 3% of rated voltage.
12. Telephone Influence Factor: TIF shall be less than 50 per NEMA MG1-22.43.
13. The diesel engine-generator set shall be capable of single step load pick up of 100% nameplate kw and power factor, with the engine-generator set at operating temperature.
14. Motor starting capability shall after an initial instantaneous voltage dip not to exceed 15 percent.

B. Engine:

1. The engine shall be water-cooled inline or Vee-type four stroke cycle compression ignition diesel. It shall meet specifications when operating on #2 Ultra Low Sulfur Diesel (ULSD). The engine shall be equipped with fuel, lube oil, and intake air filters, lube oil cooler, fuel transfer pump fuel priming pump, service meter, gear driven water pump, and unit-mounted instruments, including a fuel pressure gauge, water temperature gauge, and lubrication oil pressure gauge. All crankcase emissions shall exceed all EPA and local emissions requirements.

2. Governor - The engine governor shall maintain frequency regulation not to exceed +/-0.25% from no load to full rated load. Units shall be furnished with and electronic isochronous governor. Governor shall incorporate rack position limiter for start-up, field adjustable to minimize smoke during start-up and acceleration.
3. Mounting - The unit shall be mounted on a structural steel sub-base and shall be provided with suitable spring-type vibration isolators. Sub-base shall be sized to accommodate an under skid-mounted, double-walled fuel tank.
4. Safety Devices - Safety shut-offs for high water temperature, low oil pressure, low coolant temperature, low fuel, overspeed, and engine overcrank shall be provided. Alarm for low coolant level.
5. Engine-mounted battery charging alternator and solid-state voltage regulator.
6. Accessories: Provide replaceable type oil filters, dry-type air cleaners, lubricating oils, greases, and coolant.
7. All rotating parts shall be guarded against accidental contact.

C. Alternator:

1. The alternator shall be rated for continuous standby service at 0.8 power factor, 277/480-Volts, three phase, four wire, 60 hertz, 1800 RPM. The unit shall be capable of 100% block load per NFPA 110.
2. The A.C. generator shall be synchronous, four-pole, revolving field, drip-proof construction, single prelubricated sealed bearing, air cooled by a direct drive centrifugal blower fan, and directly connected to the engine with flexible drive disc(s). The stator shall have skewed laminations of insulated electrical grade seal, two thirds pitch windings. The rotor shall have amortissuer (damper) windings. The rotor shall be dynamically balanced. The exciter shall be brushless, three-phase, with full wave silicon diodes mounted on the rotating shaft and a surge suppressor connected in parallel with the field winding.
3. All insulation system components shall meet NEMA (MGI0221.40 and 16.40) standard temperature limits for Class H insulation system. Actual temperature rise measured by resistance method at full load shall not exceed 130ºC.
4. The main alternator and exciter insulation systems must be suitably impregnated for operation in severe environments for resistance to sand, salt, and sea spray.
5. A PMG excitation system shall derive excitation power from the main generator output.
6. Alternator should be capable of for 300% of the short circuit.
7. Regulator - A generator-mounted, volts-per-hertz-type exciter/regulator shall be provided to match the characteristics of the generator and engine. Voltage regulation shall be plus or minus 0.5% from no load to full rated load. Readily accessible voltage drop, voltage level, and voltage gain controls shall be provided. Voltage level adjustment shall be a minimum of plus or minus 5%. The solid-state regulator module shall be shock-mounted and epoxy-encapsulated for protection against vibration and atmospheric deterioration. Provide terminal box for generator and exciter leads. The regulator must be sealed from the environment and isolated from the load to prevent tracking when connected to SCR loads.

D. Cooling System:

1. Radiator - A radiator with blower type fan shall be sized to maintain safe operation at 40º C/104º F ambient temperature. The fan shall be capable of accommodating air flow restrictions external to the radiator/generator package of at least 0.5” H_20 ESP.
2. The engine cooling system shall be pre-treated by the engine supplier for the inhibition of internal corrosion.

E. Fuel System:

1. Skid and double walled tank shall be built below the structural base of the generator set and shall be sized by the manufacturer for usable capacity for **8** hours of run time plus 33% per NFPA 110. No fuel piping shall be required from fuel tank to generator. Engine shall be complete and ready to run when delivered to the site. Contractor shall provide all fuel required for site set-up and testing. After installation has been accepted, Contractor shall "top-off": base tank with No. 2 ultra low sulfur diesel fuel.

    a. Skid-mounted base fuel tank shall be UL-142 listed and meet all NFPA 30 and NFPA 37 requirements. Tank shall be equipped with a normal fuel cell vent extension to terminate 12' above grade, a fuel fill spill containment bucket and an overfill prevention valve with alarms.

2. An engine driven, mechanical, positive displacement fuel pump; fuel/water separator; fuel filter with replaceable spin-on canister element; fuel pressure gauge and fuel priming pump; flexible supply and return fuel lines.

F. Automatic Starting System:

1. Starting Motor - A D.C. electric starting system with positive engagement shall be furnished. The motor voltage shall be as recommended by the engine manufacturer.
2. Automatic Control - Fully automatic generator set start-stop controls in the generator control panel shall be provided. Controls shall provide shutdowns for low oil pressure, high water temperature, overspeed, overcrank and one auxiliary contact for activating accessory items. Controls shall include 3 complete cranking attempts without overheating before cranking cycle is lockout.
3. Jacket Water Heater - A unit-mounted thermal circulation type water heater incorporating a thermostatic switch shall be furnished to maintain engine jacket water to 90º F. The heater shall be 120-Volts, single phase, 60 hertz. Vee-type engines of 12 cylinders or more shall have one heater per each bank of cylinders.
4. Batteries - A lead acid battery set of the heavy duty diesel starting type shall be provided. Battery voltage shall be compatible with the starting system. The cold cranking amps as recommended by the engine manufacturer necessary cables and clamps shall be provided.
5. Battery Boxes - Battery boxes shall be provided for each battery and shall conform to NEC 480.9. They shall be constructed and treated as to be resistant to deterioration by battery electrolyte. Further, construction shall be such that any spillage or boil over battery electrolyte shall be contained within the box to prevent a direct path to the ground.
6. Battery Charger - A current limiting battery charger shall be furnished to automatically recharge batteries. Charger shall float at 2.17-Volts per cell and equalize at 2.33-Volts per cell. It shall include overload protection, silicon diode full wave rectifiers, voltage surge suppressor, DC ammeter, DC voltmeter, and fused AC input. AC input voltage shall be 120-Volts, single phase. Amperage output shall be not less than 5 amperes. Alarm contacts shall be provided for low voltage and battery charger failure. Charger shall be mounted in weatherproof enclosure adjacent to generator(s). Status for generator(s) shall be tied into building automation system.
7. Battery Heater- Battery heating system to be sized per manufacturer's recommendation for battery system for cold climates. System to be controlled by locate thermostat. When temperatures fall below 18º C (65º F), the thermostat activates the battery heaters, maintaining optimum battery temperature. The thermostat turns the heater off at 27º C (80º F). AC input voltage shall be 120-Volts, single phase.

G. Weatherproof Generator Enclosure

1. Reinforced steel housing allowing access to engine, generator, radiator, sub base tank and all other ancillary components.
2. Both sides will have louvers sized for cooling and combustion air intake. Both sides of housing will have full height, double hinged access doors. Doors will have not less than two latching points, operable from the inside and outside, and equipped with keyed alike locks. All enclosure walls shall have sound attenuation to reduce dB level to 75 dB at 23 feet.
3. Weather protective enclosure shall be equipped with a radiator discharge turning vane to redirect the radiator discharge air vertically.
4. Exhaust silencer shall be provided to meet the sound requirements of the specification. Flexible stainless steel connection shall be provided for each engine exhaust outlet connection to the silencer. Flex connection(s) shall be cable of isolating the exhaust silencer and building form the genset vibration. Mounting shall be provided by the Contractor. The silencer shall be mounted so that its weight is not supported by the engine, nor will the exhaust system growth, due to thermal expansion, be imposed on the engine. The exhaust back pressure shall not exceed manufacturers recommendations. Exhaust Silencer to be a critical (30dBA) grade silencer.
5. Insulation - The muffler and all indoor exhaust piping shall be lagged by the manufacturer to maintain a surface temperature not to exceed 150º F. The insulation shall be installed so that it does not cover or interfere with the functioning of the flexible exhaust fitting
6. Heat – electric heat within enclosure to maintain 40F within the generator enclosure per NFPA 110-5.3.5. Motorized louvers on intake end and gravity louvers on discharge.
7. Panel - 120/208v three phase 100A panel within the enclosure for ancillary generator loads.
8. Manufacturer shall verify all clearances of combustion air intake and radiator discharge and provide additional louvers, turning vane, etc. as required to achieve the specified rating.
9. Light fixtures interior of enclosure shall include integral battery backup and be connected to the load side of the transfer switch.

H. Main Line Circuit Breaker:

1. Type - A main line, insulated case circuit breaker with long time, short time and instantaneous trip features, mounted upon and sized to the output of the generator shall be installed as a load circuit-interrupting and protection device. It shall operate both manually for normal switching functions and automatically during overload and short circuit conditions. Generator breaker shall full coordinate with downstream devices and shall be included in coordination study.
2. The trip unit for each pole shall have elements providing inverse time delay during overload conditions and instantaneous magnetic tripping for short circuit protection provide with adjustments for long-term, short-term and instantaneous tripping. Provide ground fault alarm only where breaker is greater than 1000Amps. The circuit breaker shall meet standards established by Underwriters Laboratories, National Electrical Manufacturers Association, and National Electrical Code.
3. Generator exciter field circuit breakers do not meet the above electrical standards and are unacceptable for line protection.
4. Circuit breaker shall have battery voltage operated shunt trip wired to safety shutdowns to open the breaker in the event of engine failure.

I. Generator Control Panel:

1. Generator-mounted NEMA 1 enclosed solid state module for engine control and AC metering. Panel shall contain, but not be limited to the following equipment:

   a. Auto/Manual start-stop with LED indicators for low oil pressure, high coolant temperature, prealarm low oil pressure, prealarm high coolant temperature, low fuel, battery charger fault, low battery volts, low coolant temperature, not on auto, low coolant level, AC output fail over speed, over cranks and emergency stop. Safety shut-downs shall be automatic.
   b. Cyclic-cranking as specified by NFPA 110.
   c. Adjustable cool down timer (0-30 minutes).
   d. LCD readout for: engine oil pressure, coolant temperature, engine RPM, system DC volts, engine running hours, generator AC volts, generator AC amps and generator frequency.
   e. Engine control switch.
   f. Ammeter - Voltmeter phase selector switch.
   g. Emergency stop pushbutton.
   h. Indicator/display test switch.
   i. Voltage adjustment raise/lower switches.
   j. Auxiliary relay, 3PDT.
   k. Padlocking provisions.
   l. Lamp test switch.

2. Generator control panel shall be unit mounted and installed not more than 6’6” above the finished floor adjacent to the engine/generator set. Where control panel may be above the specified 6’6”, the Electrical Subcontractor shall provide a working platform adjacent to the engine/generator set which will allow proper access to maintenance personnel (control panel within 6’6” of platform). Provide catwalk if height condition cannot be met.
3. Remote Alarm Annunciator: Comply with NFPA 110. An LED labeled with proper alarm conditions shall identify each alarm event and a common audible signal shall sound for each alarm condition. Silencing switch in face of panel shall silence signal without altering visual indication. Connect so that after an alarm is silenced, clearing of initiating condition will reactivate alarm until silencing switch is reset. Cabinet and faceplate are surface- or flush-mounting type to suit mounting conditions indicated. Annunciator shall include manual start/stop and transfer control capabilities of generator(s) and transfer switch(es).
4. Remote Emergency-Stop Switch: Comply with NEC 445.18(A) & (B) NFPA 110-5.6.5.6. Flush and wall mounted, unless otherwise indicated, and labeled. Push button shall be protected from accidental operation. Located outside of the enclosure.

J. NFPA Requirements:

1. Annunciator Panel – Two panels shall be provided for remote mounting to give audible and visual warning of fault or alarm conditions in the generator set. In addition, panel shall have generator start/stop switch. The panel shall conform to requirements of the National Electrical Code, and the National Fire Protection Association publication NFPA-110A. The panels shall be located in the building security office and Fire Command Center.

K. Schedules:

1. In order to forecast and minimize engine failure, the supplier of the equipment must provide an oil sampling analysis kit which operating personnel shall utilize for scheduled oil sampling.

2. Scheduled oil sampling shall be accurate within a fraction of one part per million for the following elements:

    a. Iron
    b. Chromium
    c. Copper
    d. Aluminum
    e. Silicon
    f. Lead

3. The sample shall be tested for the presence of water, fuel dilution, and anti-freeze.

L. Generator Pad

1. Contractor shall provide a house keeping pad for the generator. Pad shall be a minimum of 4” high.
2. Confirm placement of anchor bolts and vibration isolators with manufacturers shop drawings.

M. System Service Contract:

1. The supplier of the standby power system must provide a copy and make available to the owner their standard service contract which, at the Owner’s option, may be accepted or refused. This contract will accompany any documents, drawings, catalog cuts, specification sheets, wiring or outline drawings, etc. submitted for approval to the designing engineer. The Contract shall be for the complete services rendered over a period of one year.

N. Temporary Generator Connection:

1. Description: Permanent temporary generator connection cabinet.
2. Bussing: Provide copper of aluminum bussing as indicated on the one-line diagram.
3. Voltage: 480/277V, 3 phase, 4 wire, 4 pole.
4. Enclosure: NEMA 3R steel construction with hinged access covers.
5. Cam Lock Connectors: Provide E1016 type camlock connectors sized to carry at a minimum the bus ampacity.
6. Interlock: Provide electrical interlock between temporary generator connection and building generator output shunt trip breaker so that only one can operate at a time.

    a. Provide two position switch on connection cabinet – “Permanent Building Generator” and “Temporary Generator”.
    b. Provide auxiliary contacts and control wiring to the Fire Command Center to an annunciator indicating that the permanent building generator is offline.

7. Load Bank Connection: Provide connection for temporary load bank with E1016 type camlock connectors. Provide load dump control method to remove load bank on loss of utility power.
8. Labeling: Provide permanent labeling on enclosure. Label shall include at a minimum the following:

    a. Voltage.
    b. Ampacity.
    c. Phase rotation.
    d. Bonding requirements.
    e. AIC rating.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions under which diesel engine-driven generator units are to be installed and notify Engineer in writing of conditions detrimental to proper completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF DIESEL ENGINE-DRIVEN GENERATOR SETS

A. Install diesel engine-driven generator units in accordance with the equipment manufacturer's written instructions, and with recognized industry practices, to ensure that engine-generator units fulfill requirements. Comply with NFPA and NEMA standards pertaining to installation of engine-generator sets and accessories.

B. Coordinate with other work, including raceways, electrical boxes and fittings, fuel tanks, piping and accessories, as necessary to interface installation of engine-generator equipment work with other work.

C. Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturers' published torque tightening valves for equipment connectors. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL Standards 486A, 486B, and the National Electrical Code.

D. Install units on vibration isolators in accordance with Division 23 section; and comply with manufacturer's indicated method of installation.

E. Connect fuel oil piping to alternative generator equipment as indicated, and comply with manufacturer's installation instructions.

F. Align shafts of engine and generator within tolerances recommended by engine-generator unit manufacturer.

G. Generator set shall be capable of start-up and accepting rated load within ten (10) seconds to meet NFPA 110.

H. Provide all conduit and wiring from building panelboard to feed miscellaneous equipment such as jacket heaters, battery charger, etc.

I. Provide all control wiring for remote annunciation and controls.

J. All control wiring shall be kept independent of all other wiring. Any loss of integrity of control wiring shall start the generator.

3.3 GROUNDING

A. Provide equipment grounding connections for diesel engine-driven generator units. Tighten connections to comply with tightening torques specified in UL Standard 486A to assure permanent and effective grounding.

3.4 FIELD QUALITY CONTROL

A. Start-up Testing:

1. Engage local equipment manufacturer's representative to perform start-up and building load tests upon completion of installation, with the Architect/Engineer in attendance; provide certified test record. Tests are to include the following:

   a. Check fuel, lubricating oil, and antifreeze in liquid cooled models for conformity to the manufacturer's recommendations under environmental conditions present.
   b. Test prior to cranking engine for proper operation, accessories that normally function while the set is in a standby mode. Accessories include engine heaters, battery charger, generator strip heater, remote annunciator.
   c. Check, during start-up test mode, for exhaust leaks, path of exhaust gases outside the building, cooling air flow, movement during starting and stopping, vibration during running, normal and emergency line-to line voltage and phase rotation.
   d. Test, by means of simulated power outage, automatic start-up, remote-automatic starting, transfer of load, and automatic shut-down. Prior to this test adjust for proper system coordination, transfer switch timers. Monitor throughout the test, engine temperature, oil pressure, battery charge level, generator voltage, amperes, and frequency

2. Perform a eight-hour test with the following sequence:

   a. Four hours 100% load of rating for generator.
   b. Two hours 75% load of rating for generator.
   c. Two hours 50% load of rating for generator.

   (Test results shall be documented and given to the engineer for review and approval.)

3. Upon completion of installation demonstrate capability and compliance of system with requirements. Where possible, correct malfunctioning units at site, then retest to demonstrate compliance; otherwise, remove and replace with new units, and proceed with retesting. Initial testing and retesting to be at no cost to Owner.

B. Simulated Power outage. Preform full building shut down and test of the emergency power system. Test elevator recall function with transfer of power. Coordinate test with engineer and AHJ to witness the test.

3.5 MANUALS

A. In addition to the requirement of Section 26 05 00, provide 2 sets of complete manuals containing warranty, operational and maintenance instructions, recommendations for spare parts, routing servicing of the system, name, address, telephone number of factory authorized local service agency. One copy to be located in main electrical room and second with the generator.

B. Provide Preventive Maintenance Schedules as recommended by the manufacturer.

3.6 IDENTIFICATION

A. Provide identification nameplates for components as detailed in Section 26 05 53.

3.7 PERSONNEL TRAINING

A. Building Operating Personnel Training: Train Owner's building personnel in procedures for starting-up, testing and operating diesel engine-driven generator sets. In addition, train Owner's personnel in periodic maintenance of batteries. Provide one full day of training.

END OF SECTION

SECTION 26 36 23 - AUTOMATIC TRANSFER SWITCHES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provision of Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work of this section.

B. Division 26 Basic Electrical Materials and Methods sections apply to work specified in this section.

1.2 SUMMARY

A. Extent of transfer switch work, including associated control devices, is indicated by drawings and schedules and as specified herein.

B. Types of transfer switches required for the project include the following:

1. Automatic transfer.

C. Refer to other Division 26 sections for wires/cables, electrical raceways, boxes and fittings, which are required in conjunction with transfer switch work; not work of this section.

D. Refer to Division 3 sections for concrete and grout work required in connection with transfer switch work; not work of this section.

E. Refer to Division 26 section for vibration control and isolation required in connection with transfer switches; not work of this section.

1.3 SUBMITTALS

A. Product Data: Submit manufacturer’s data and installation instructions for electrical power transfer switches.

B. Shop Drawings: Submit 1/2”=1’-0” scale layout drawings of electrical generator and transfer switches showing accurately scaled equipment locations, housekeeping pad size, location and spatial relationships to associated electrical equipment in proximity.

C. Wiring Diagrams: Submit wiring diagrams for electrical transfer switches, and associated control devices showing connections to prime and alternate power sources, electrical load, and equipment components. Differentiate between portions of wiring that are manufacturer-installed and portions that are field-installed.

1.4 QUALITY ASSURANCE

A. Manufacturer's Qualification: Firms regularly engaged in manufacture of electrical power transfer switches, of types, rating, and capacities required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Installer's Qualifications: Firm with at least 5 years of successful installation experience on projects utilizing electrical power transfer switches similar to that required for this project.

C. Codes and Standards:

1. Electrical Code Compliance: Comply with applicable local electrical code requirements of the authority having jurisdiction and NEC as applicable to construction and installation of electrical power transfer switches.
2. UL Compliance: Comply with applicable requirements of UL 1008, "Automatic Transfer Switches", and UL 486A, "Wire Connectors and Soldering Lugs for Use with Copper Conductors." Provide transfer switches and components which are UL-listed and labeled.
3. NEMA Compliance: Comply with applicable requirements of NEMA Standards Pub/No.'s ICS 2, "Industrial Control Devices, Controllers and Assemblies", ICS 6 and 250, pertaining to transfer switches.
4. NFPA Compliance: Comply with applicable requirements of NFPA 99; "Standard for Health Care Facilities", and NFPA 101; "Code for Safety to Life from Fire in Buildings and Structures", pertaining to transfer switches.

1.5 DELIVERY, STORAGE AND HANDLING

A. Deliver transfer switches and associated devices in factory-fabricated type containers or wrappings, which properly protect equipment from damage.

B. Store transfer switches and associated devices in original packaging and protect from weather and construction traffic. Wherever possible, store indoors; where necessary to store outdoors, store above grade and enclose with watertight wrapping.

C. Handle transfer switches and associated devices carefully to prevent physical damage to equipment. Do not install damaged equipment; remove from site and replace damaged equipment with new equipment.

PART 2 - PRODUCTS

2.1 TRANSFER SWITCHES

A. General: Except as otherwise indicated, provide manufacturer's standard design, materials and components as indicated by published product information, designed and constructed as recommended by manufacturer for duty indicated, and as required for a complete installation.

B. Automatic Transfer Switches shall be provided with 3 or 4 poles (as indicated on the drawings), current ratings as indicated on the drawings, for a normal and emergency source of 480-Volts, 3 phase, 4 wire, 60Hz with neutral bus. The transfer switch shall be braced to have a short circuit rating as indicated on the drawings. The transfer switches shall be listed per UL Standard 1008 as a recognized component for emergency systems and rated for total system load. The pickup voltage shall be adjustable from 85% to 98% of nominal and the dropout voltage shall be adjustable from 75% to 98% of the pickup value.

C. The automatic transfer switches shall be mechanically held, electrically operated type and suitable for continuous duty in an unventilated sheet metal enclosure without derating (NEMA Type A IEC Type PC). The transfer switches shall be inherently double throw so both sets of contacts move simultaneously when the switch is transferring.

D. Delay Transition: The transfer switches shall be mechanically interlocked to ensure only three possible positions-normal, neutral and emergency. Delay transfer switches shall be provided for all standby transfer switches.

E. Open Transition: The transfer switches shall be mechanically interlocked to ensure only two positions-normal and Emergency. Open transition transfer switches shall be provided for all life safety/emergency transfer switches.

F. All main contacts shall be silver alloy wiping action type. They shall be protected by arcing contacts in sizes above 400 amperes.

G. All switch and relay contacts, coils, springs and control elements shall be removable from the front of the transfer switch without removal of the switch panels from the enclosure and without disconnection of drive linkages or power conductors. Sensing and control relays shall be continuous duty industrial control type with minimum contact rating of 10 amperes.

H. Automatic transfer switches utilizing components of molded case circuit breakers, circuit interrupters, disconnect switches, or parts thereof which had not been intended for repetitive switching are not acceptable. An overload or short-circuit shall not cause the transfer switch to go into neutral position.

I. A time delay to override momentary normal source outages to delay all transfer switch and engine starting signals. The time delay shall be field adjustable from 0.5 to 15 seconds and factory set at 3 seconds.

J. The switch shall transfer the load to the emergency power system after the generator set reaches proper voltage and frequency. Time delay transfer to emergency power adjustable from 0 to 120 seconds (set at 5 seconds) shall allow the engine-generator set to stabilize before application of load.

K. A time delay on retransfer to normal source. The time delay shall be automatically bypassed if the emergency source fails and normal source is available. The time delay shall be field adjustable from 0 to 30 minutes and factory set at 15 minutes.

L. Independent single phase voltage and frequency sensing of the emergency source. The pickup voltage shall be adjustable from 85% to 98% of nominal. Transfer to emergency upon normal source failure when emergency source voltage is 90% or more of nominal.

M. Transfer switch shall be factory equipped with a means to prevent large inrush currents due to transfer between energized sources. This feature shall provide a field adjustable time delay during switching in both directions, during which time the load is isolated from both power sources, to allow residual voltage of motors or other inductive loads (such as transformers) to decay before completing the switching cycle. The programmed transition feature shall have an adjustable time range of 0 to 7.5 seconds. All transfer switched specified to be supplied without programmed transition shall be capable of addition of the programmed transition feature in the field without transfer switch replacement. Transfer methods that use the phase relationships between the two power sources to control a transfer initiation time are not acceptable.

N. A contact that closes when normal source fails for initiating engine starting, rated 10 amps, 32-Volt D.D. Contacts to be gold plated for low-voltage service.

O. Pilot lights to show switch position.

P. The ATS shall have an elevator pre-transfer signal if it serves an elevator.

Q. Two set of normally open and one set of normally closed auxiliary contacts.

R. A test switch to momentarily simulate normal source failure.

S. Harnessing between transfer switch and control panel shall have built-in disconnect for routine maintenance.

T. Transfer switch shall be furnished with an operator's manual providing installation and operating instructions.

U. Transfer switch shall be supplied in a NEMA 1 enclosure.

V. Transfer switch shall be furnished with an adjustable exerciser circuit. Selectable exercise time of the day of month, time of day, and duration shall be provided.

W. The control module shall direct the operation of the transfer switch. The module's sensing and logic shall be a built-in microprocessor-based system for maximum reliability, minimum maintenance, and inherent digital communications capability. The control settings shall be stored in nonvolatile EEPROM. The module shall contain an integral programmable clock and calendar. The control module shall have a keyed disconnect plug to enable the control module to be disconnected from the transfer mechanism for routine maintenance. The control module shall be mounted separately from the transfer mechanism unit for safety and ease of maintenance. Interfacing relays shall be industrial control grade plug-in type with dust cover.

X. The control module shall include programming keypad, alpha-numeric display for monitoring settings and diagnostic values, key-lockable program selector switch, light-emitting diode status indications, and user instructions. These features shall be user accessible when the enclosure door is closed.

Y. The control module shall be capable of storing the following records in memory for access either locally (at the control module) or remotely (at a computer):

1. Number of hours transfer switch is in the emergency position (total and since record reset).
2. Number of hours the emergency is available (total and since record reset).
3. Total transfers in either direction (total and since record reset).
4. Date of record reset.
5. Date of last exercise period.
6. Date, time, and description of the last four source failures.
7. Elapsed time during the most recent source outage.

Z. Provide permanent label indicating maximum available fault current at the transfer switch.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions under which transfer switches are to be installed and notify Engineer in writing of conditions detrimental to proper completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF TRANSFER SWITCHES

A. Install transfer switches, including associated control devices as indicated, in accordance with equipment manufacturer's written instructions, and with recognized industry practices, to ensure that transfer switches comply with requirements. Comply with applicable requirements of NEC and NFPA pertaining to wiring practices and installation of electrical power transfer switches.

B. Coordinate with other electrical work, including raceway, and electrical boxes and fittings, as necessary to interface installation of transfer switch work with other work.

C. Tighten electrical connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for equipment connectors. Where manufacturer's torquing requirements are no indicated, tighten connectors and terminals to comply with tightening torques specified in UL Standards 486A and B.

D. Provide in conjunction with each and every automatic transfer switch the following:

1. 2# 12-1"C from auxiliary contact (closed when switch in emergency position) on transfer switch to each elevator machine room which is served via that transfer switch. Terminate as and where required by the elevator vendor.
2. 2# 12-1"C from auxiliary contact (closed before switch returns to normal power) on transfer switch serving elevators to each elevator machine room which is served via that transfer switch. Terminate as and where required by the elevator vendor.
3. 2# 12-1"C from engine start contact on transfer switch to respective emergency generator control panel and remote annunciator panels with start and stop controls.
4. 2# 12-1"C from auxiliary contacts on fire pump controller for generator start.
5. Wiring as necessary from transfer switch to remote annunciator panels and engine control panel for transfer switch position indicator lights.
6. All generator control wiring shall be routed in a 2-hour rated enclosure.
7. Wiring shall be kept entirely independent of all other wiring.
8. A loss of continuity of the generator control wiring shall start the generator.

E. Provide all necessary wiring and conduit to each remote alarm panel located at the fire command center and security office. Remote alarm panel shall include manual transfer control.

3.3 GROUNDING

A. Provide equipment grounding connections for transfer switch units as indicated. Tighten connectors to comply with tightening torques specified in UL Standard 486A to assure permanent and effective grounding.

3.4 FIELD QUALITY CONTROL

A. Test transfer switches, by means of simulated power outage; automatic start-up by remote-automatic starting, transfer of load and automatic shutdown. Prior to these tests, adjust transfer switch timers for proper system coordination.

B. Upon completion of installation and after circuitry has been energized, demonstrate capability and compliance of transfer switches with requirements. Where possible, correct malfunctioning units at site then retest to demonstrate compliance; otherwise, remove and replace with new units, and proceed with retesting. Initial testing and retesting, where necessary, at no cost to Owner.

3.5 FIELD QUALITY CONTROL

Tests shall conform to International Electrical Testing Association (INETA) Standard ATS, “Acceptance Testing Specifications for Electrical Power Distribution Equipment”.

A. Infrared Inspection (After Energized)

1. All equipment should be energized at normal load levels for at least 1 to 2 hours prior to being scanned.
2. Access covers are to be removed and reinstalled by the electrical Contractor for the Engineer to inspect and scan all electrical junctions, buss, and cable.
3. The IR Scan will be made using a Flir Thermal Imaging Camera. The camera shall provide infrared photos clearly indicating problem areas.
4. All problem areas will be noted as to location, description, and recommended solution by providing a typed report including infrared and digital pictures of all problem areas.

B. Visual and Mechanical Inspection:

1. Inspect for physical damage and code violations.
2. Inspect for proper alignment, anchorage and grounding.
3. Inspect for proper identification of protective devices and switches.
4. Check tightness of accessible bolted buss joints.
5. Physically test all electrical or mechanical interlocks to assure proper function.
6. Clean interior and insulator surfaces once a month prior to job completion.
7. Inspect for proper operation of space heaters and thermostat settings (if they exist).

C. Electrical Tests:

1. Measure insulation resistance of each buss section phase-to-phase and phase-to-ground.
2. Check switchboards for electrical continuity of circuits and for short circuits.

3.6 PERSONNEL TRAINING

A. Building Operating Personnel Training: Train Owner’s building personnel in procedures for starting-up, testing and operating transfer switches and auxiliary equipment.

END OF SECTION

SECTION 26 41 13 - LIGHTNING PROTECTION FOR STRUCTURES

PART 1 - GENERAL

1.1 SUMMARY

A. Provide a UL Master Labeled, approved lightning protection system.

1.2 QUALITY ASSURANCE

A. ANSI/NFPA 780; Lightning Protection Installation Standard

B. ANSI/UL 96; Listed Lightning Protection Components.

C. UL 96A; Installation Requirements for Lightning Protection Systems.

D. Lightning Protection Institute (LPI) Standard 175

1.3 SYSTEM DESCRIPTION

A. Lightning Protection System (LPS): A complete lightning protection system consisting of air terminals, interconnecting conductors, bonding, and grounding as required to obtain the UL Master Label. The LPS designer shall utilize the current IEC 62 305-2 standard to determine the geometric method to be employed in the design of the LPS. These calculations will determine the required Lightning Protection Level, the LPS class and ultimately the spacing of the air terminals. The calculations shall be included in the submittal package for the LPS to the engineer.

1.4 SUBMITTALS

A. IEC 62 305-2 calculations used to determine the design criteria of the LPS.

B. Submit shop drawings showing:

1. Layout of all air terminals, grounding electrodes, conductor sizes and bonding connections to the structure and other metal objects.
2. Shop drawings shall include shaded area noting the “area of protection” from higher roofs or other LPS equipment, where that “protection” has been designed utilizing zones of protection calculations. The method/formula and written calculations for determining each “area of protection” shall be included in the submittal package to the engineer.

C. Submit product data that includes all pertinent information and the materials of each component, and include the current UL listing number in accordance with ANSI/UL 96.

D. Submit manufacturer’s detailed installation instructions.

E. Submit the installers Statement of Work (SOW) detailing the plan of installation, from beginning to completion.

F. Submit the UL documentation of the manufacturers' listing.

G. Submit the UL documentation of the LPS installers' listing.

1.5 PROJECT RECORD DOCUMENTS

A. Accurately record the actual locations of air terminals, grounding electrodes, bonding connections, and routing of system conductors. The "as-built" drawings shall be submitted to the engineer along with the UL Master Label submittal at the completion of the system installation.

1.6 QUALIFICATIONS

A. Manufacturer:

1. Company specializing in lightning protection equipment with minimum five (5) years experience, documented with their UL Listing. Refer to section 260503 for approved manufacturers.

B. Installer:

1. Authorized installer of manufacturer with minimum five (5) years documented experience with Underwriters Laboratories.
2. Submit documentation of listing of the LPS installer with the UL Follow-Up Services include this documentation with the required shop drawings submittals.

PART 2 - PRODUCTS

2.1 PRODUCTS

A. Components: In accordance with ANSI/UL 96 AND NFPA 780.

1. Air Terminals: Aluminum
Minimum Size Air Terminal for Class I Copper 3/8" x 12"
(Perimeter 20' Spacing Maximum and for equipment only)
Minimum Size Air Terminal for Class II Copper 1/2" x 12"
(Perimeter 20' Spacing Maximum and for equipment only)
Minimum Size Air Terminal for Class I Copper 3/8"x 26"
(Mid-Roof 50' Spacing Maximum, braced)
Minimum Size Air Terminal for Class II Copper 1/2" x 26"
(Mid-Roof 50' Spacing Maximum, braced)
Perimeter and Mid-Roof Air Terminals shall be equipped with an anti-impalement adapter for safety.

2. Grounding Plate: Shall be Copper, Aluminum – not listed or approved

Minimum Acceptable Size Ground Plate	3'x 3' Square Foot Copper Plate with factory installed pigtail conductor with an irreversible connection to the plate.

3. Conductors: Aluminum Solid or Stranded Conductors

Minimum Size Conductor for Class I Copper	#2 Stranded
Minimum Size Conductor for Class II Copper	2/0 Stranded
Minimum Size Secondary CU Bonding Conductor	#6 Solid
Minimum Size Conductor for Class I Aluminum	1/0 Stranded
Minimum Size Conductor for Class II Aluminum	4/0 Stranded
Minimum Size Secondary AL Bonding Conductor	#4 Solid

4. All conductors within 18" of the ground shall be Copper.
5. Connectors and Irreversible Splicers: Bronze, Copper or Aluminum
6. Stamped connectors, splicers, bond plates or air terminal bases shall not be allowed in the LPS.
7. Ground Rods: UL Listed, Copper Clad Steel with irreversible cable to ground rod connections
8. Minimum Size Ground Rod 3/4" x 10'
9. Raceway shall have a minimum size of 1-1/4".

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that surfaces are ready to receive work.

B. Beginning of installation means installer accepts existing conditions.

3.2 PROTECTION OF SURROUNDING ELEMENTS

A. Protect elements surrounding the work of this Section from damage or disfiguration.

3.3 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install in accordance with UL 96A and ANSI/NFPA 780.

C. The Lightning Protection System (LPS) shall be bonded to the grounding electrode systems according to the current National Electric Code (NEC).

D. Install the LPS in a neat and workmanlike manner.

E. Coordination with other trades.

1. Roofing Contractor

a. Roofing contractor is responsible for pads and or pavers, if required by the roofing manufacturer.
b. Roofing contractor is responsible for sealing and flashing of roof penetrations for lightning protection system, to insure the roofing manufacturers' warranty.
c. Roofing contractor is responsible for communicating warranty requirements, to the LPS installer, in writing, before the installation of the lightning protection system begins.

2. Electrical Contractor(EC)/General Contractor(GC)

a. EC/GC is responsible for sleeves through roofs, floors and out of foundations for the LPS down-conductors.
b. EC is responsible for 1" conduit for down-conductors; conduit shall meet local code requirements of the AHJ. Structural steel shall not be utilized as the sole down-conductor system but shall be bonded into the LPS.
c. EC is responsible for all of the Surge Protection Devices (SPD) requirements of the LPS. These devices shall be compliant for use with a lightning protection system by UL.

3.4 CORROSION PROTECTION

A. Do not combine materials that can form an electrolytic couple that will accelerate corrosion in the presences of moisture unless moisture is permanently excluded from junction of such materials.

B. Use conductor with protective coatings where conditions cause deterioration or corrosion of conductors.

3.5 FIELD QUALITY CONTROL

A. Obtain the services of Underwriters Laboratories, Inc. to provide inspection and certification of the lightning protection system under provisions of UL 96A.

B. Obtain UL Master Label and deliver the UL Master Label Document to the Owner.

The UL Master Label is now an electronic document and is valid for only 5 years from date of issuance

C. The grounding system shall be tested to meet 10 Ohms or less, using the fall of potential method. A written report, with the form being acceptable to the engineer, and meeting current industry standards, shall be submitted for project records. If the resistance is over 10 Ohms, the installing contractor shall test the soil resistance and calculate a method for obtaining the 10 Ohms or less to the engineer for review. The engineer will decide how to proceed.

END OF SECTION

SECTION 26 43 13 - SURGE PROTECTIVE DEVICE (SPD) (SELENIUM ENHANCED)

PART 1 - GENERAL

1.1 SUMMARY

A. This specification includes requirements for a high energy, field-mounted, Surge Protective Device (SPD) Type 1 (formerly known as Secondary Surge Arrestor) and SPD Type 2 (formerly known as Transient Voltage Surge Suppressor) electronic filtering system used to protect low-voltage AC electrical distribution from the effects of lightning, utility switching events, temporary over voltages (TOV), and impulses generated internally within a facility.

1.2 RELATED DOCUMENTS

A. The specified unit shall be designed, manufactured, tested and installed in compliance with the following standards:

1. ANSI/IEEE C62.41.1-2002, C62.41.2-2002 and C62.45-2002
2. Canadian Standards (CUL)
3. Federal Information Processing Standards Publication 94 (FIPS PUB 94)
4. National Fire Protection Association (NFPA 70 (NEC), 75 and 78)
5. Underwriters Laboratories (UL 96A, 198, 248-1, 489, 1283 and 1449-Forth Edition)

1.3 SUBMITTALS

A. Product Data: Provide complete product data detailing manufacturer's model number, specifications, features and options. Substitute/alternate products require pre-approval, and shall only be considered if the Attachment 1 SPD Submittal Compliance Form is fully completed and submitted at least fourteen (14) days prior to bid date.

B. Test Data: Certified documentation shall be provided of the product's UL 1449 Forth Edition certification, as tested by Underwriters Laboratories (UL). Data shall include type classification (Type 1, Type 2), voltage protective rating (VPR), actual MCOV test value, nominal discharge current test (I_n) rating, as well as surge current fuse testing, single pulse surge current capacity testing, and minimum repetitive surge current capacity testing.

C. Shop Drawings: Provide electrical and mechanical drawings that include detail on unit dimensions, weights, field connections and mounting provisions.

D. Installation, Operation and Maintenance Manuals: Provide one copy of the installation, start-up, operation and maintenance data for each unit supplied.

1.4 ACCEPTABLE MANUFACTURER

A. These specifications detail performance requirements for a selenium-enhanced suppression system manufactured by Current Technology/ABB. Substitute, value-engineered or alternate products shall meet all performance and reliability aspects of this specification, including the substitute/alternate products submittal requirements. The surge suppression and noise filtering unit shall be as follows:

1. Service Entrance and Switchboard Locations: Current Technology Model # SL3-150
2. Critical Panelboard Locations: Current Technology Model #TG3-100.
3. Emergency Distribution Panelboard Locations: Current Technology/ABB Model OVR.
4. Note: A national sales agreement for the Current Technology products is managed by Challenge Technology in Colorado. Call 303-421-9400 for details.

1.5 SUBSTITUTION PRE-APPROVAL PROCEDURES

A. Manufacturers requesting approval of their products shall identify the full model number and submit product data, specifications, submittal test data from Section 1.3.B, and complete the Attachment 1 SPD Submittal Compliance Form at least fourteen (14) days prior to the bid date.

1.6 WARRANTY

A. The manufacturer shall provide a twenty (20) year limited warranty for SL3-150 units, fifteen (15) year limited warranty for TG3-100 units, and five (5) year limited warranty for OVR units from the date of shipment against failure when installed in compliance with applicable national/local electrical codes and the manufacturer’s installation, operation and maintenance instructions.

1.7 LOCAL SERVICE SUPPORT

A. A dedicated support organization shall be located within 150 miles of the project location, and shall have experience supporting at least twenty other projects of similar complexity within the last three years. Personnel shall perform a start-up service to verify correct installation of the filters, perform transient voltage tests for reliability and performance using appropriate surge generating test equipment, and respond on-site to investigate user concerns.

PART 2 - PRODUCTS

2.1 HIGH PERFORMANCE SUPPRESSION SYSTEM

A. The suppression system shall incorporate a hybrid design of selenium cells (for service entrance and switchboard locations only), metal oxide varistor (MOV) arrays and filtering capacitors. These components shall optimally share surge currents to ensure maximum performance and long-term reliability. The system shall not utilize gas tubes, spark gaps, silicon avalanche diodes, or other components that might short or crowbar the line, thus leading to power interruption.

2.2 UL 1449 FORTH EDITION UL TYPE 1 AND TYPE 2 DEVICE

A. The unit shall be certified as a Type 2 device suitable for use in Type 1 applications. The Type 1 rated test current shall be 20 KA, and the applied MCOV value shall be the actual MCOV of the unit's suppression components (i.e. between 115% and 130% of nominal installed voltage, according to Section 2.4).

2.3 UNIT OPERATING VOLTAGE

A. The operating voltage and configuration shall be 277/480-Volt or 120/208-Volt grounded wye as indicated on the drawings.

2.4 MAXIMUM CONTINUOUS OPERATING VOLTAGE (MCOV)

A. The MCOV shall be greater than 115 percent (%) of nominal voltage, but no greater than 130 percent (%).

2.5 PROTECTION MODES

A. All modes shall be protected (e.g., line-to-line, line-to-neutral, line-to-ground and neutral-to-ground).

2.6 RATED SINGLE PULSE SURGE CURRENT CAPACITY

A. Calculations for single pulse surge current capacity shall use the component manufacturer's individual component rating multiplied by the respective number of per mode components. Documentation shall be provided with submittals on the Attachment 1 TVSS Submittal Compliance Form. Component manufacturer's ratings shall be derived using the ANSI/IEEE C62.41-1991 Category C1 8 X 20 µsec, 3000A current waveform. The per mode single pulse surge current rating shall be calculated based upon the component manufacturer's catalog rating for each device. The minimum rated single pulse surge current capacity per mode and per phase rating shall be as follows:

Rated Single Pulse Surge Current Capacity				
Location	L-N Per Mode	L-G Per Mode	N-G Per Mode	Per Phase
Service Entrance & Switchboards	150,000 A	150,000 A	150,000 A	300,000 A
Critical Panelboards	100,000 A	100,000 A	100,000 A	200,000 A
Emergency Distribution Panelboard Locations	25,000 A	25,000 A	25,000 A	50,000 A

2.7 TESTED SINGLE PULSE SURGE CURRENT CAPACITY

A. The suppression filter system shall be single pulse surge current tested in all modes at rated surge currents by an industry-recognized independent test laboratory. Units with surge current capacities of 200,000 amps or less shall be tested as a unit, not individual modules. Due to industry test equipment limitations, units with surge current capacities greater than 200,000 amps shall be tested as a unit to 200,000 amps; and certified for surge current ratings above 200,000 amps by testing individual components or sub- assemblies within a mode. Units that sustain any component or overcurrent device failure or degradation are unacceptable.

2.8 MINIMUM REPETITIVE SURGE CURRENT CAPACITY

A. Per ANSI/IEEE C62.41 and ANSI/IEEE C62.45-1992, every mode of the suppression filter system shall be designed to survive multiple Category C 20 KV, 10 KA impulses. Test documentation shall detail the unit's ability to survive the following number of events (at one minute intervals) without any performance degradation.

Repetitive Surge Current Capacity - Number of Impulses				
Locations	Per Phase	L-N	L-G	N-G
Service Entrance & Switchboards	>29,000	>14,500	>14,500	>14,500
Critical Panelboards	>14,000	>7000	>7000	>7000

2.9 TEMPORARY OVERVOLTAGE (TOV) RATING

A. For service entrance and switchboard locations only, suppression components shall be capable of withstanding TOV events (swells). Depending on available fault current, the unit shall withstand without failure of overcurrent protection or suppression components multiple TOVs of 200 percent (above RMS nominal voltage) for 60 cycles or greater, without component failure (including fuses).

2.10 HIGH FREQUENCY EXTENDED RANGE FILTER

A. EMI-RFI noise rejection/attenuation (per MIL-STD-220B January 2000) shall be a minimum of 54.6 dB.

2.11 UL 1449 FORTH EDITION VOLTAGE PROTECTIVE RATING

A. The voltage protective rating (VPR) for grounded wye circuits at applicable voltage shall not exceed the following:

System Voltage	Mode	UL 1449 Forth Edition VPR
120/208	Line to Line (L-L) Line to Neutral (L-N) Line to Ground (L-G) Neutral to Ground (N-G)	1000 700 700 700
277/480	Line to Line (L-L) Line to Neutral (L-N) Line to Ground (L-G) Neutral to Ground (N-G)	2000 1200 1200 1000

2.12 REDUNDANT OVERCURRENT PROTECTION

A. Each suppression element shall utilize individual 200 KAIC tested fuses to ensure that the failure of a single suppression component, or operation of any single fuse does not render the entire mode, phase or product deficient by more than fifty percent (50%). At service entrance locations only, in the event a catastrophic or swell voltage occurrence causes the failure of all the MOV elements, the fusing for the selenium cells shall be independent to provide redundancy. All fuses shall be capable of withstanding the rated single pulse surge current capacity of the individual components they protect without failure.

2.13 INTERNAL CONNECTIONS

A. Internal surge current paths shall utilize low-impedance copper bus bar. No plug-in modules or quick-disconnect terminals shall be used in the surge current-carrying paths.

2.14 BUILT-IN FIELD TEST CAPABILITY AND MONITORING INDICATION

A. The unit shall incorporate an integral test point for off-line diagnostic testing to verify operational integrity of the suppression filter system. Testing shall include injection of an impulse at least two times the nominal system voltage, and provide metering to indicate the resultant clamping voltage. The unit shall also include tri-color indicating lights that provide the status of the internal fusing, to include indication of partial degradation of surge current capacity capability (N/A for OVR model).

2.15 ENCLOSURE

A. The service entrance unit shall utilize a NEMA 4 metallic enclosure.

2.16 ADDITIONAL FEATURES/EQUIPMENT

A. Advanced Monitoring Feature. A battery-powered audible alarm with event counter display and two sets of form C dry contacts (N.O. or N.C.) shall be provided. The alarm shall indicate single or multiple phase failure of the filter.

PART 3 - EXECUTION

3.1 INSTALLATION

A. The service entrance, switchboard, and panelboard filters shall be installed external to the switchgear/panelboard as close as possible to the connection point following the manufacturer's recommendations for conductor size and minimal bends. If the installed lead length exceeds five feet, installer shall utilize a low impedance (HPI) cable.

3.2 EQUIPMENT MANUAL

A. An equipment manual shall be provided that details installation, operation, and maintenance instructions for the filter. Information shall include unit dimensions, weights, mounting provisions, connection details and a layout diagram.

ATTACHMENT 1 - SPD SUBMITTAL COMPLIANCE FORM
(SERVICE ENTRANCE AND SWITCHBOARDS)

Performance/Feature	Specification Requirement	Proposed
UL Listed Type 1 & Type 2 Rated, 20 KA NDCT, MCOV Used in Test	Type 1 Rated/Listed - Yes Type 2 Rated/Listed - Yes 20 KA Tested - Yes UL MCOV – 320-Volts	Type 1/Listed Rated - _____ Type 2/Listed Rated - _____ 20 KA Tested - _____ UL MCOV - _____Volts
Single Pulse Surge Rating Per Mode	150 KA L-N 150 KA L-G 150 KA N-G	_____ L-N _____ L-G _____ N-G
Single Pulse Surge Rating Per Phase	300 KA L-N + L-G	_____ L-N + L-G
Number Of Components Used For Above Rating	L-N: 4, L-G: 4; N-G: 4 Each component rated for 50,000 transient amps and selenium	Number of MOV's/Mode L-N _____ L-G _____ N-G _____
Documentation of Rating	Independent Test Reports	
Warranty For Damage To TVSS Due To Lightning	20 years	
Dispatch Location For Local Support And Start-Up		
Maximum Continuous Operating Voltage (MCOV) For All Suppression Components	Greater than 115 percent and less than 130 percent	
Temporary Overvoltage Capacity	**200% for ≥ 60 Cycles**	
Protection Modes Provided	**L-L, L-N, L-G and N-G**	
Category C3 Repetitive Surge Current Capacity (per mode/phase)	> 14,500/29,000 impulses	
High Frequency Noise Filtering Attenuation	Minimum 54.6 dB	Minimum of ____ dB
Internal Surge Current Path	Copper Bus Bar	
Field Test Capability With Surge Generator and Multi-Color Fuse Indication	Required? ___ No X Yes	Provided? ___ No ___ Yes If Yes, How? _____ _____
Individually Fused Elements Individual Fuse Surge Current Rating	Required? ___ No X Yes ~50,000 Transient Amps	Provided? ___ No ___ Yes _____ Transient Amps
Alarm & Disturbance Counter	Required? ___ No x Yes	Provided? ___ No ___ Yes
Microprocessor-Based Diagnostics	Required? ___ No x Yes	Provided? ___ No ___ Yes
Enclosure	Metal NEMA 4	

ATTACHMENT 1 - SPD SUBMITTAL COMPLIANCE FORM (PANELBOARDS)

Performance/Feature	Specification Requirement	Proposed
UL Type 1 & Type 2 Rated, 20 KA NDCT, MCOV Used in Test	Type 1 Rated/Listed - Yes Type 2 Rated/Listed - Yes 20 KA Tested - Yes UL MCOV – 150-Volts	Type 1/Listed Rated - _____ Type 2/Listed Rated - _____ 20 KA Tested - _____ UL MCOV - _____Volts
Single Pulse Surge Rating Per Mode	100 KA L-N 100 KA L-G 100 KA N-G	_____ L-N _____ L-G _____ N-G
Single Pulse Surge Rating Per Phase	200 KA L-N + L-G	_____ L-N + L-G
Number Of Components Used For Above Rating	L-N: 2, L-G: 2; N-G: 2 Each component rated for 50,000 transient amps	Number of MOV's/Mode L-N _____ L-G _____ N-G _____
Documentation of Rating	Independent Test Reports	
Warranty For Damage To TVSS Due To Lightning	15 years	
Dispatch Location For Local Support And Start-Up		
Maximum Continuous Operating Voltage (MCOV) For All Suppression Components	Greater than 115 percent and less than 130 percent	
Protection Modes Provided	**L-L, L-N, L-G and N-G**	
Category C3 Repetitive Surge Current Capacity (per mode/phase)	> 7000/14,000 impulses	
High Frequency Noise Filtering Attenuation	Minimum 54.6 dB	Minimum ____ dB
Internal Surge Current Path	Copper Bus Bar	
Field Test Capability With Surge Generator and Multi-Color Fuse Indication	Required? ___ No X Yes	Provided? ___ No ___ Yes If Yes, How? _____
Individually Fused Elements UL 248-1 Recognized Fuses Individual Fuse - Surge Current Rating	Required? ___ No X Yes Required? ___ No X Yes ~50,000 Transient Amps	Provided? ___ No ___ Yes Provided? ___ No ___ Yes _____ Transient Amps
Disturbance Counter	Required? ___ No x Yes	Provided? ___ No ___ Yes
Microprocessor-Based Diagnostics	Required? ___ No x Yes	Provided? ___ No ___ Yes

END OF SECTION

SECTION 26 43 14 - SURGE PROTECTIVE DEVICE (SPD)

PART 1 - GENERAL

1.1 SUMMARY

A. This specification includes requirements for a high energy, field-mounted, Surge Protective Device (SPD) Type 1 (formerly known as Secondary Surge Arrestor/TVSS) and SPD Type 2 (formerly known as Transient Voltage Surge Suppressor) electronic filtering system used to protect low-voltage AC electrical distribution from the effects of lightning, utility switching events, temporary over voltages (TOV), and impulses generated internally within a facility.

1.2 RELATED DOCUMENTS

A. The specified unit shall be designed, manufactured, tested and installed in compliance with the following standards:

1. ANSI/IEEE C62.41.1-2002, C62.41.2-2002 and C62.45-2002
2. Canadian Standards (CUL)
3. Federal Information Processing Standards Publication 94 (FIPS PUB 94)
4. National Fire Protection Association (NFPA 70 (NEC), 75 and 78)
5. Underwriters Laboratories Listed (UL 96A, 198, 248-1, 489, 1283 and 1449-Forth Edition)

1.3 SUBMITTALS

A. Product Data: Provide complete product data detailing manufacturer’s model number, specifications, features and options.

B. Test Data: Manufacturers shall submit certified independent 3rd party test data verifying the following: life cycle testing, overcurrent protection, UL1449 Forth Edition as tested by Underwriters Laboratories (UL), noise attenuation and surge current capacity. Data shall include type classification (Type 1, Type 2), voltage protective rating (VPR), actual MCOV test value, nominal discharge current test (I_n) rating.

C. Shop Drawings: Provide electrical and mechanical drawings that include detail on unit dimensions, weights, field connections and mounting provisions.

D. Installation, Operation and Maintenance Manuals: Provide one copy of the installation, start-up, operation and maintenance data for each unit supplied.

E. Complete the specification compliance form at the end of this section.

1.4 ACCEPTABLE MANUFACTURER

A. These specifications detail performance requirements for a surge suppression system manufactured by Current Technology/ABB, Citel (Panelboards only), Emerson/Liebert, Square D/Schneider, Eaton/Bussmann, General Electric, Mersen, Siemens, or Thor. Substitute, value-engineered or alternate products shall meet all performance and reliability aspects of this specification, including the substitute/alternate products submittal requirements.

1.5 SUBSTITUTION PRE-APPROVAL PROCEDURES

A. Manufacturers requesting approval of their products shall identify the full model number and submit product data and specifications, and complete the Attachment 1 SPD Submittal Compliance Form at least fourteen (14) days prior to the bid date.

1.6 WARRANTY

A. The manufacturer shall provide a fifteen (15) year limited warranty from the date of shipment against failure when installed in compliance with applicable national/local electrical codes and the manufacturer's installation, operation and maintenance instructions.

1.7 LOCAL SERVICE SUPPORT

A. A dedicated support organization shall be located within 150 miles of the project location, and shall have experience supporting at least twenty other projects of similar complexity within the last three years.

PART 2 - PRODUCTS

2.1 HIGH PERFORMANCE SUPPRESSION SYSTEM

A. The suppression system shall incorporate metal oxide varistor (MOV) arrays and filtering capacitors. These components shall optimally share surge currents to ensure maximum performance and long-term reliability. The system shall not utilize gas tubes, spark gaps, silicon avalanche diodes, or other components that might short or crowbar the line, thus leading to power interruption.

2.2 UL 1449 FORTH EDITION UL TYPE 1 AND TYPE 2 DEVICE

A. The unit shall be certified as a Type 2 device suitable for use in Type 1 applications. The Type 1 rated test current shall be 20 KA, and the applied MCOV value shall be the actual MCOV of the unit's suppression components (i.e. between 115% and 130% of nominal installed voltage, according to Section 2.4).

2.3 UNIT OPERATING VOLTAGE

A. The operating voltage and configuration shall be 277/480-Volt or 120/208-Volt grounded wye as indicated on the drawings.

2.4 MAXIMUM CONTINUOUS OPERATING VOLTAGE (MCOV)

A. The MCOV shall be greater than 115 percent (%) of nominal voltage, but no greater than 130 percent (%).

2.5 PROTECTION MODES

A. All modes on all phases shall be protected (e.g., line-to-line, line-to-neutral, line-to-ground and neutral-to-ground).

2.6 RATED SINGLE PULSE SURGE CURRENT CAPACITY

A. Calculations for single pulse surge current capacity shall use the component manufacturer's individual component rating multiplied by the respective number of per mode components. Documentation shall be provided with submittals on the Attachment 1 TVSS Submittal Compliance Form. Component manufacturer's ratings shall be derived using the ANSI/IEEE C62.41-1991 Category C1 8 X 20 µsec, 3000A current waveform. The per mode single pulse surge current rating shall be calculated based upon the component manufacturer's catalog rating for each device. The minimum rated single pulse surge current capacity per mode and per phase rating shall be as follows:

Rated Single Pulse Surge Current Capacity				
Location	L-N Per Mode	L-G Per Mode	N-G Per Mode	Per Phase
Service Entrance & Switchboards	125,000 A	125,000 A	125,000 A	250,000 A
Panelboards	50,000 A	50,000 A	50,000 A	100,000 A

2.7 MINIMUM REPETITIVE SURGE CURRENT CAPACITY

A. Per ANSI/IEEE C62.41 and ANSI/IEEE C62.45-2002, every mode of the suppression filter system shall be designed to survive multiple Category C 20 KV, 10 KA impulses. Test documentation shall detail the unit's ability to survive the following number of events (at one minute intervals) without any performance degradation.

Repetitive Surge Current Capacity - Number of Impulses				
Locations	Per Phase	L-N	L-G	N-G
Service Entrance & Switchboards	>15,000	>7500	>7500	>7500
Panelboards	>10,000	>5000	>5000	>5000

2.8 HIGH FREQUENCY EXTENDED RANGE FILTER

A. EMI-RFI noise rejection/attenuation (per MIL-STD-220B January 2000) shall be a minimum of 54.6 dB.

2.9 UL 1449 FORTH EDITION VOLTAGE PROTECTIVE RATING

A. The voltage protective rating (VPR) for grounded wye circuits at applicable voltage shall not exceed the following:

System Voltage	Mode	UL 1449 Forth Edition VPR
120/208	Line to Line (L-L) Line to Neutral (L-N) Line to Ground (L-G) Neutral to Ground (N-G)	1200 700 700 700
277/480	Line to Line (L-L) Line to Neutral (L-N) Line to Ground (L-G) Neutral to Ground (N-G)	2000 1200 1200 1000

2.10 REDUNDANT OVERCURRENT PROTECTION

A. Each suppression element shall utilize individual tested fuses to ensure that the failure of a single suppression component, or operation of any single fuse does not render the entire mode, phase or product deficient by more than fifty percent (50%). All fuses shall be capable of withstanding the rated single pulse surge current capacity of the individual components they protect without failure.

2.11 INTERNAL CONNECTIONS

A. Internal surge current paths shall utilize low-impedance copper bus bar. No plug-in modules or quick-disconnect terminals shall be used in the surge current-carrying paths.

2.12 ENCLOSURE

A. The service entrance unit shall utilize a NEMA 4 metallic enclosure for interior locations.

2.13 ADDITIONAL FEATURES/EQUIPMENT

A. Advanced Monitoring Feature. A battery-powered audible alarm with event counter display and two sets of form C dry contacts (N.O. or N.C.) shall be provided. The alarm shall indicate single or multiple phase failure of the filter. The unit shall also include tri-color indicating lights that provide the status of the internal fusing, to include indication of partial degradation of surge current capacity capability.

PART 3 - EXECUTION

3.1 INSTALLATION

A. The switchboard and panelboard filters shall be installed internal to the switchgear/panelboard as close as possible to the connection point following the manufacturer's recommendations for conductor size and minimal bends. If the installed lead length exceeds five feet, installer shall utilize a low impedance (HPI) cable.

B. All insulation resistance tests shall be performed without being connected to the distribution equipment.

3.2 START UP SERVICES

A. Complete start up checks according to manufacturer's written instructions.

3.3 EQUIPMENT MANUAL

A. An equipment manual shall be provided that details installation, operation, and maintenance instructions for the filter. Information shall include unit dimensions, weights, mounting provisions, connection details and a layout diagram.

ATTACHMENT 1 - SPD SUBMITTAL COMPLIANCE FORM
(SERVICE ENTRANCE AND SWITCHBOARDS)

Performance/Feature	Specification Requirement	Proposed
UL Listed Type 1 & Type 2 Rated, 20 KA NDCT, MCOV Used in Test	Type 1 Rated/Listed - Yes Type 2 Rated/Listed - Yes 20 KA Tested - Yes UL MCOV – 320-Volts	Type 1/Listed Rated - _____ Type 2/Listed Rated - _____ 20 KA Tested - _____ UL MCOV - _____Volts
Single Pulse Surge Rating Per Mode	150 KA L-N 150 KA L-G 150 KA N-G	_____ L-N _____ L-G _____ N-G
Single Pulse Surge Rating Per Phase	300 KA L-N + L-G	_____ L-N + L-G
Number Of Components Used For Above Rating	L-N: 4, L-G: 4; N-G: 4 Each component rated for 50,000 transient amps and selenium	Number of MOV's/Mode L-N _____ L-G _____ N-G _____
Documentation of Rating	Independent Test Reports	
Warranty For Damage To TVSS Due To Lightning	20 years	
Dispatch Location For Local Support And Start-Up		
Maximum Continuous Operating Voltage (MCOV) For All Suppression Components	Greater than 115 percent and less than 130 percent	
Temporary Overvoltage Capacity	200% for ≥ 60 Cycles	
Protection Modes Provided	L-L, L-N, L-G and N-G	
Category C3 Repetitive Surge Current Capacity (per mode/phase)	> 14,500/29,000 impulses	
High Frequency Noise Filtering Attenuation	Minimum 54.6 dB	Minimum of ____ dB
Internal Surge Current Path	Copper Bus Bar	
Field Test Capability With Surge Generator and Multi-Color Fuse Indication	Required? ___ No X Yes	Provided? ___ No ___ Yes If Yes, How? _____ _____
Individually Fused Elements Individual Fuse Surge Current Rating	Required? ___ No X Yes ~50,000 Transient Amps	Provided? ___ No ___ Yes _____ Transient Amps
Alarm & Disturbance Counter	Required? ___ No x Yes	Provided? ___ No ___ Yes
Microprocessor-Based Diagnostics	Required? ___ No x Yes	Provided? ___ No ___ Yes
Enclosure	Metal NEMA 4	

ATTACHMENT 1 - SPD SUBMITTAL COMPLIANCE FORM (PANELBOARDS)

Performance/Feature	Specification Requirement	Proposed
UL Type 1 & Type 2 Rated, 20 KA NDCT, MCOV Used in Test	Type 1 Rated/Listed - Yes Type 2 Rated/Listed - Yes 20 KA Tested - Yes UL MCOV – 150-Volts	Type 1/Listed Rated - _____ Type 2/Listed Rated - _____ 20 KA Tested - _____ UL MCOV - _____Volts
Single Pulse Surge Rating Per Mode	100 KA L-N 100 KA L-G 100 KA N-G	_____ L-N _____ L-G _____ N-G
Single Pulse Surge Rating Per Phase	200 KA L-N + L-G	_____ L-N + L-G
Number Of Components Used For Above Rating	L-N: 2, L-G: 2; N-G: 2 Each component rated for 50,000 transient amps	Number of MOV's/Mode L-N _____ L-G _____ N-G _____
Documentation of Rating	Independent Test Reports	
Warranty For Damage To TVSS Due To Lightning	15 years	
Dispatch Location For Local Support And Start-Up		
Maximum Continuous Operating Voltage (MCOV) For All Suppression Components	Greater than 115 percent and less than 130 percent	
Protection Modes Provided	**L-L, L-N, L-G and N-G**	
Category C3 Repetitive Surge Current Capacity (per mode/phase)	> 7000/14,000 impulses	
High Frequency Noise Filtering Attenuation	Minimum 54.6 dB	Minimum ____ dB
Internal Surge Current Path	Copper Bus Bar	
Field Test Capability With Surge Generator and Multi-Color Fuse Indication	Required? ___ No X Yes	Provided? ___ No ___ Yes If Yes, How? _____
Individually Fused Elements UL 248-1 Recognized Fuses Individual Fuse - Surge Current Rating	Required? ___ No X Yes Required? ___ No X Yes ~50,000 Transient Amps	Provided? ___ No ___ Yes Provided? ___ No ___ Yes _____ Transient Amps
Disturbance Counter	Required? ___ No x Yes	Provided? ___ No ___ Yes
Microprocessor-Based Diagnostics	Required? ___ No x Yes	Provided? ___ No ___ Yes

END OF SECTION

This page is intentionally left blank.

SECTION 26 51 00 – LIGHTING FIXTURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Interior lighting fixtures
2. Exterior lighting fixtures
3. Lamps, power supplies, and accessories

B. Section Excludes:

1. Emergency lighting units
2. Exit signs
3. Lighting fixture supports
4. Lighting Controls

C. Related Sections:

1. Section 26 05 19 – Electrical Power Conductors and Cables
2. Section 26 09 13 - Electrical Power Monitoring
3. Section 26 09 36 – Modular Lighting Controls
4. Section 26 24 13 – Distribution Switchboards
5. Section 26 24 16 – Panelboards
6. Section 26 27 26 - Wiring Devices

1.2 STANDARDS AND REFERENCES

A. American National Standards Institute/Institute of Electrical and Electronic Engineers (ANSI/IEC/CIE/IEEE) (www.ansi.org)

1. C78.377 – Specifications for the Chromaticity of Solid State Lighting (SSL) Products
2. C78.374 – Light Emitting Diode Package Specification Sheet for General Illumination Applications
3. C82.16 – American National Standard for Light-Emitting Diode Drivers – Method of Measurement
4. C82.15 – American National Standard for Light-Emitting Diode Drivers – LED Driver Robustness Test
5. IEEE PAR1789
6. ANSI/ASHRAE/IES Standard 90.1 – Lighting
7. CIE TC1-69 – Color Quality Scale

B. International Energy Conservation Code (IECC)

1. C405 – Electrical Power and Lighting Systems

C. Illuminating Engineering Society (IES) (www.ies.org)

1. The Lighting Library
2. RP-16-2010
3. LM-79, LM-80, LM-82, LM-84, LM-85, LM-86, LM-88, TM-21, TM-25-13, TM-26, TM-27-14, TM-28, TM-30-15, TM-87

D. Underwriters Laboratories, Inc. (UL) (www.ul.com):

1. 8750-2015

E. JEDEC

1. JESD51-50, JESD51-51, JESD51-52, JESD51-53

F. National Electrical Manufacturers Association (NEMA)

1. SSL-1, SSL-4, SSL-6, SSL-7A
2. LSD-44, LSD-45, LSD-49, LSD-51, LSD-55, LSD-60, LSD-63, LSD-68

G. American Society of Agricultural and Biological Engineers (ASABE) (*www.asabe.org)*
H. ASTM International (ASTM) (www.astm.org)
I. Canadian Standards Association (CSA) (www.csa.ca)
J. International Electrotechnical Commission (www.iec.ch)
K. International Organization for Standardization (ISO)

1. 9001:2000 – Quality Management Systems

1.3 SYSTEM DESCRIPTION

A. Luminaires shall be provided as specified in the Luminaire Schedule or as indicated on the Contract Drawings complete with lamps, power wiring, and control for a fully operational system.
B. Catalog numbers indicated in the Luminaire Schedule are a design series reference and do not necessarily represent the exact catalog number, size, voltage, wattage, driver, finish, ceiling type, mounting hardware, or special requirements as specified or as required by the particular installations.
C. Luminaires, components, and installation shall be in accordance with the American National Standards Institute, the latest revision of the National Electrical Code (N.E.C.) and applicable federal, state, and local codes and regulations.
D. Luminaires, drivers, ballasts, transformers, and other electrical components shall be manufactured in strict compliance with the appropriate requirements of the Underwriter's Laboratories, Inc. and others that may be applicable. The appropriate Underwriter's Laboratories, Inc. labels shall be affixed to luminaires.
E. The Contractor shall coordinate the installation of luminaires with mounting surfaces and materials installed under other sections or by others. Coordinate the work with placement of supports, hangers, spacers, stems, aligner canopies, auxiliary junction boxes, and other hardware as required for a complete and proper mounting. Coordinate compatibility of luminaires and associated trims with mounting surfaces at installed locations. All recessed luminaires shall have frames, flanges, or trims that are compatible with the installed ceiling system. All luminaires shall be provided with all mounting and installation accessories as required for a complete and proper installation.

F. The Contractor shall be responsible for luminaire quantities, lengths and clearances required and shall inform the Design Team and/or Owner in writing, at the time the bid submission is made, of discrepancies or variances found with fixtures or details specified herein or in the luminaire schedule and other contract documents.
G. If equal or alternate luminaire Manufacturers are not indicated, the luminaire shall be provided as specified.
H. If equal or alternate luminaire Manufacturers are indicated, proposed fixtures substitutions shall be limited to those Manufacturers listed.
I. The Lighting Consultant is not responsible for the performance of substituted luminaires approved by the Architect and/or Owner without the consent of, or review by, the Lighting Consultant.

1.4 DEFINITIONS

A. BF: Ballast factor.
B. CCT: Correlated color temperature.
C. CRI: Color rendering index.
D. IP: International Protection or Ingress Protection Rating.
E. LED: Light emitting diode.
F. LER: Luminaire efficacy rating.
G. Lumen: Measured output of lamp and luminaire, or both.
H. Luminaire: Complete lighting fixture, including lamp, reflector, housing, and power supply.
I. SSL: Solid state lighting
J. U.L.: Underwriter's Laboratories, Inc.

1.5 SUBMITTALS

A. Submit under provisions of Section 013000 – Submittal Procedures, for submittal purposes.
B. Shop Drawings and Product Data Submittals:

1. Within fourteen days of contract award, successful Contractor shall submit a complete list of lighting products intended to be furnished with manufacturer and catalog designations, along with currently quoted lead times for delivery of same. The lead times shall include time allotted for shop drawing completion and review for those fixtures requiring such. Should the Contractor anticipate that the delivery schedule of specified product may adversely impact the construction schedule, it shall be brought to the attention of the owner at this time. Request for fixture substitution on the basis of delivery schedule will not be permitted.
2. Within fourteen days of bid award, the Contractor shall provide a complete list of lamps, which will be furnished on the project. This list shall be organized alphabetically by the luminaire type indicated on the luminaire schedule, and include the manufacturer and exact model number of each lamp. Up to three samples of any listed lamp shall be supplied at no additional cost to the project, if so requested by the Design Team and/or Owner.
3. Alternate products other than those listed by name in the specification will not be considered without prior written consent from the Design Team and/or Owner.
4. Submit shop drawings and product data in accordance with the requirements of the general conditions and as described herein and elsewhere in the contract documents.
5. The Contractor shall submit data for approval of the Architect, detailed shop drawings and product data for luminaires specified herein and elsewhere in the contract documents. Luminaires shall not be installed without the approval of its shop drawings, product data and/or sample.

6. Shop drawings and product data shall indicate the name of the project, fixture type, manufacturer's name, luminaire catalog number and catalog number for lampholders, components, ballasts, drivers, or transformers, diffusers, accessories, internal protective components and all necessary information including, but not limited to: detail of luminaire, clearances, dimensions, components, mounting hardware, method of field assembly, materials and weights; other pertinent information, to show compliance with contract documents with regard to metal thickness and support methods.
7. Prior to fabrication and submittal of the shop drawings and product data, the Contractor shall coordinate luminaires and conduit entries with equipment, ducts, pipes, openings, etc.
8. Custom luminaire fabrication details shall be drawn at either full size or half-size scale. Fixture fabrication details shall illustrate a minimum of three critical views indicating fabrication and assembly methods, materials, and materials' gauges and finishes, and specifications of lighting equipment and appropriate electrical, mounting and accessory hardware.
9. Where luminaires are mounted in continuous rows or in architectural coves, shop drawings shall indicate exact luminaire locations, layout, connecting components, coupling plates, changes in elevation, corner details, assembly methods, and reinforced concrete base details.
10. Submit product data which includes luminaire type, luminaire illustration with mounting details, luminaires certification of suitability for use in locations indicated, and photometric test reports which include the following:

    a. Complete candlepower summary with graphical and numerical data in 5 degree increments for up and down quadrants and at 22-1/2 degree azimuth increments including normal and parallel.
    b. Visual comfort probability data.
    c. Coefficients of utilization data.
    d. Luminaire efficiency.
    e. Lamp description.
    f. Lamp lumen output.
    g. Zonal lumens and percentages.

11. Substitutions

    a. Substitutions for the specified lighting products are not acceptable and will not be considered. Failure to include one of the specified products as a part of the base bid may, at the discretion of the owner, invalidate the entire lighting product bid and exclude the contractor from further consideration.
    b. Should the Contractor elect to consider products other than those specified, the items must be submitted fourteen days in advance of the bid. Failure to submit within that deadline constitutes a guarantee that the specified products will be supplied. The lighting designer will invoice the contractor, at senior designer hourly rates, to review any product not listed in the specification. Submittal of a bid for this project shall include a written acknowledgment of these terms from the contractor.
    c. Substitutions shall be submitted in accordance with the requirements of the general conditions and as described herein and elsewhere in the contract documents.
    d. The Manufacturer shall submit, upon request, a prototype sample of the substitute luminaire for evaluation of compliance with the contract documents. Shop drawings will not be acceptable in place of the prototype. A submittal for evaluation shall be an operable 120 volt non-returnable sample, complete with lamp(s), 72 inch grounded cord and plug and the specified finish.

e. The Architect will be the sole judge in determining whether the prototype sample complies with the contract documents and reserves the right to disqualify proposed manufacturer or submitted item.
f. Photometric test reports shall be submitted for each luminaire offered in substitution for a luminaire specified.

1.6 SAMPLES:

A. Upon request, submit samples of custom luminaires, modified, and substitution items (including substitutions from Manufacturers included as Acceptable Alternates) for the purpose of ascertaining photometric performance, quality of visible parts and details, maintenance features, methods of installation, and safety features. These samples shall be submitted for approval at no expense to the Owner or Design Team, with transportation prepaid. The samples will be returned to the Contractor after the review has been completed at the expense of the Contractor.
B. Upon request, submit finish samples from Manufacturers for review of finishes, including any custom finishes.

1.7 SPECIALTY LUMINAIRES:

A. All custom luminaires require a prototype as part of submittals and to be submitted prior to commencement of fabrication, unless otherwise directed by the Owner. The prototype shall be a working sample with the same diffuser, material, finishes, etc. as the specification. The purpose of the prototype will be to review construction, lamp placement within luminaire, lamp type, optical assembly, finishes, etc. Modification may be required as a result of the prototype review. These modifications and others that do not materially affect the cost of the luminaire shall be incorporated at no additional cost to the Owner, Architect, Lighting Designer, or Engineer.

1.8 CLOSEOUT SUBMITTALS

A. Operating and Maintenance Data: For all lighting equipment and luminaires to include emergency, operation, and maintenance manuals.

1. Provide a list of all luminaires, lamps, drivers, ballasts, and transformers used on the project; use ANSI and Manufacturer’s codes.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Deliver luminaires individually wrapped in factory fabricated fiberboard type containers.
B. Handle luminaires carefully to prevent breakage, denting, and scouring of the luminaire finish.
C. Store products in a clean, conditioned, dry space, protected from weather and in original manufacturer’s packaging in accordance with manufacturer’s written instructions until ready for installation.
D. Luminaires shall be protected from dust during installation.

1.10 QUALITY ASSURANCE

A. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by an independent testing agency, with the experience and capability to conduct the testing indications, that is an NRTL as defined by OSHA in 29 CFR 1910.7.
B. Comply with NFPA 70, as required by federal, state, and local codes.
C. Specified Manufacturers are listed to define the requirements for quality and function of the specified product.
D. All luminaires shall meet all required local, state, and/or national building, electrical, and energy codes and regulations.
E. Mockups: Provide luminaires for mock-ups as requested by the Design Team and/or Owner.

1. Obtain Design Team and Owner's approval of luminaires for mockups prior to starting installations.
2. Remove mockups when directed. Sample luminaire for mockup may be reinstalled with consent of the Owner.
3. Install luminaires for mockups with power and control connections.

1.11 COORDINATION

A. Coordinate layout and installation of luminaires and components with all other trades.

1.12 WARRANTY

A. Comply with Division 1 requirements.
B. General Warranty: Any special warranty specified in this Section shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.
C. Special Warranty for Luminaires and Components: Manufacturer's standard form in which manufacturer of luminaire agrees to repair or replace components that fail in materials or workmanship within a specified warranty period.

1. Warranty period for LED luminaires: Five (5) years from date of Substantial Completion.
2. Warranty period for all other luminaires: One (3) year from date of Substantial Completion.
3. Warranty period for drivers: Five (5) years from date of Substantial Completion.
4. Warranty period for ballasts and transformers: Three (3) years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with requirements, provide products as listed in the Light Fixture Schedule.

2.2 GENERAL REQUIREMENTS FOR LUMINAIRES AND COMPONENTS

A. Recessed Fixtures: Comply with NEMA LE 4.
B. Luminaires shall be manufactured to the specifications described above and as indicated in the Light Fixture Schedule and Contract Documents. Acceptable alternate Manufacturers are

included in the Light Fixture Schedule. No other alternate Manufacturers will be considered without written consent of the Design Team.

C. Provide proper thickness of code gauge sheet steel so that luminaires are rigid, stable, and will resist deflection, twisting and warping under normal installation procedures, re-lamping, and maintenance.

D. Luminaire designs shall include, as applicable, plaster frames, trim rings, shrouds, flanges, backboxes, support hardware, and other components required for proper installation of the luminaire.

E. Luminaires with covers, cones, or diffuser frames, which are to be mounted above twelve feet from the finished floor level, shall be provided with safety chains or other acceptable backup means of support to properly secure such items to main housing.

F. Fixtures shall be Underwriter Laboratory approved for their application and location and have the appropriate U.L. label adhered to the fixture visible within the housing of each fixture.

G. Rows of luminaires shall be designed with concealed splice plates and shall be free of light leaks. Components such as reflectors, trims, diffusers and other visible items shall be properly aligned with no overlaps, gaps, or other imperfections.

H. Adjustable fixtures interior and exterior shall provide methods to lock fixture in place. This includes rotation and tilt adjusting.

I. Hardware shall be concealed where it is appropriate, unless it is a design feature.

J. Where hardware is exposed the hardware is to be painted to match adjacent surfaces unless otherwise noted.

K. Materials, accessories, and other related fixture parts shall be new and free of defects, which may impair their character, appearance, strength, ability, or function. Fixtures must be protected from damage from the time of fabrication until final acceptance of work.

L. Contractor is responsible for coordination of special mounting conditions for custom fixtures and must supply necessary mounting devices.

M. Fixtures shall be completely wired at the factory. Fixtures shall come with electrical wiring in accordance with local codes and in accordance with actual installation requirements.

N. Provide neoprene gasketing, stops, and barriers where required to prevent light leak and/or water and water vapor penetrations. Luminaires installed in the following, but not limited to, locations shall have neoprene gasketing:

1. Locker rooms
2. Aquatic areas
3. Aquatic mechanical equipment rooms
4. Kitchens

O. Provide finished product with smooth clean ground metal edges, trims, and frames as well as tight fitting connections, hinges, and closures.

P. Provide access for servicing the installed luminaire and for replacement of electrical parts without removal or disassembly of the luminaire.

Q. Unless otherwise noted, provide emergency battery packs or stand-by systems as required for luminaires connected to emergency circuits.

R. All luminaires shall operate on normal/emergency power, unless otherwise directed by the Design Team.

S. Low voltage fixtures which use a remote transformer must be supplied with transformers as necessary to complete a working installation. Transformers must be supplied by the fixture manufacturer or approved by the fixture manufacturer to maintain the U.L. rating.

T. Lead wires for luminaires utilizing tungsten halogen lamps shall be rated for not less than 200°C operation, and shall be rated for 250°C when temperature warrants. Minimum individual fixture wiring shall be number 18 gauge. Terminate wiring for recessed fixtures, except fluorescent units, in external splice box.

U. Luminaire doors shall be provided as follows: Positive light seal, concealed safety hinges, and inconspicuous "positive spring loaded" holding latches, which are hingeable from either side and operable without the use of tools.
V. Where luminaires are mounted in tandem in continuous uplight or downlight coves, the Contractor shall field coordinate fixture quantity and length required to provide a continuous band of light without gaps to within 6" of row ends.
W. All sconces shall be provided with recessed junction boxes.
X. Remote drivers shall be concealed from view of the public and located in accordance with Design Team recommendations.

2.3 SOLID STATE LIGHTING (LED)

A. General:

1. Manufacturer shall have a minimum of five (5) years experience in the Manufacturer and design of LED products and systems and no less than one hundred (100) North American installations.
2. Include all components necessary for a complete installation. Provide all power supplies, synchronizers, data cables, and data terminators for a complete working system.
3. All peripheral devices and control software are to be provided by and shall be the responsibility of a single entity. All components shall perform successfully as a complete system and shall operate as described in control narrative documents.
4. All LED sources used in LED luminaire shall be of proven quality from established and reputable LED Manufacturers.
5. Prior to the shipment of the luminaires from the factory, all luminaires shall be tested with all components to ensure the luminaire is functioning properly.

B. Replacement and Spares:

1. Manufacturers shall keep record of original bin for each LED module and have replacement modules from the same bin available for three (3) years after the date of installation. System components shall not become obsolete for five (5) years. Manufacturer shall keep an inventory of replacement parts (source assembly, power and control components) or provide replacement parts that fit into the original luminaire and provide equivalent distribution and lumen output to the original.
2. All parts of system shall be replaceable in field. Manufacturer shall accept returned product and/or components for recycling or re-use.
3. System shall carry a full warrantee for a minimum of five (5) years. Manufacturer shall be responsible for cost of labor to replace any component of the system that fails within 2 years of Substantial Completion.

C. Products and Components – Performance

1. LED luminaries and components shall be UL listed or UL classified, CE certified, and PSE marked.
2. The diodes that make up the LED board shall not vary in correlated color temperature by more than or less than 100K.
3. All LEDs of the same type shall be from the same production facility and the same production run.

4. All manufacturing processes and materials shall conform to the requirements of the European Union's Restriction on the Use of Hazardous Substances in Electrical and Electronics Equipment (RoHS) Directive, 2002/95/EC.
5. LEDs shall comply with ANSI/NEMA/ANSLG C78-377-2008 – Specifications for the Chromaticity of Solid State Lighting Products.
6. Dedicated white LEDs shall have a rated source life of a minimum of 50,000 hours under normal operating conditions, unless otherwise specified.
7. Maximum power consumption for the luminaire shall be determined by the application. The luminaire shall not consume power in the off state
8. The luminaire shall operate from 60HZ AC line over a voltage ranging from 108 VAC to 305 VAC. The fluctuations of the line voltage shall have no visible effect of the luminous output.
9. Total harmonic distortion (current and voltage) induced into an AC power line by a luminaire shall not exceed 10 percent.
10. To ensure fixture quality, fixture shall have been tested under accelerated life test conditions including an operating temperature span of 160 degrees C, and cyclic loading up to 60G.
11. The luminaire on-board circuitry shall include fused surge protection devices to withstand high repetition noise transients as a result of utility line switching, lightning strikes, and other interferences. The surge protection device shall protect the luminaire from damage and failure for common mode transient peak voltages up to 10kV (minimum) and transient peak current up to 5 kA (minimum). The surge protection device shall be UL listed and shall be tested per the procedures in ANSI/IEEE.
12. The circuitry shall prevent all visible flicker to the naked eye over the voltage range specified above.
13. The depreciation of the light from the luminaire shall not exceed 30 percent over the expected operating life.
14. Fixture assembly shall include a method of dissipating heat so as to not degrade life of source, electronic equipment, or lenses. LED fixture housing shall be designed to transfer heat from the LED board to the outside environment. Fixture housing shall have no impact on life of components.
15. Manufacturer shall supply a range of permissible operating temperatures in which system will perform optimally.
16. High power LED fixture shall be thermally protected using one or more of the following thermal management techniques: metal core board, gap pad, and/or internal monitoring firmware.
17. All products included in system shall use Mil-Std 810F, Random Vibration 7.698g as a minimum standard. In installations subject to vibration, luminaries shall be installed with vibration isolation hardware to sufficiently dampen vibrations.
18. For wet and damp use, LED-based luminary itself shall be sealed, rated, and tested for appropriate environmental conditions, not accomplished by using an additional housing or enclosure.
19. All hardwired connections to LED fixtures shall be reverse polarity protected and provide high voltage protection in the event connections are reversed or shorted during the installation process.
20. The LED luminaire shall be operated at constant and carefully regulated current levels. LEDs shall not be overdriven beyond their specified nominal voltage and current.
21. RBG LED fixtures shall utilize an equal combination of high brightness red, blue and green LEDs, unless otherwise noted, to provide up to 16.7 million additive RGB colors and shall be capable of at least 8-bit control.
22. Manufacturer shall be able to provide supporting documentation of the product meeting third party regulatory compliance.

23. Manufacturer shall ensure that products undergo and successfully meet appropriate design and manufacturability testing including Design FMEA, Process FMEA, Environmental Engineering Considerations and Laboratory Tests, IEC standards and UL/CE testing.
24. All LED fixtures (100% of each lot) shall undergo a minimum eight-hour burin-in test during manufacturing.
25. Manufacturer shall provide optical performance, polar diagrams, and relevant luminance and illuminance photometric data based on test results from an independent Nationally Recognized Testing Lab (NRTL).
26. Manufacturer shall provide photometric data in IES file format in accordance with IES LM-63-2002, based on test results from an independent NRTL.
27. Manufacturer shall provide mechanical, electrical, network communication and environmental specifications.

    a. LED fixture shall be network controllable via digital control.
    b. The LED system shall use integral and differential nonlinear control.
    c. Constant data transmission rates shall be employed, resulting in the output being independent of distance of cable between power supply and light source within the specified length.
    d. Power/data supply outputs shall have current limiting protection.
    e. Power/data supply shall provide miss-wiring protection.
    f. Power/data supply shall have power factor correction.
    g. Power/data supply shall provide connections that are conduit-ready or clamp-style connections in the case of low-voltage wiring.
    h. Power/data supply shall come with a housing that meets a minimum IP20 rating for dry location installation
    i. Power/data supply shall be UL listed for Class 1 or Class 2 wiring

28. LED system shall have a selectable means of external control via a data network.

D. Each LED fixture and /or node shall have the capability to be set to a unique and individual address. Address shall be selectable through on board switches or by an external hardware of software method.
E. Retrofit lamps

1. Shall meet DOE's Energy Star or Design Light Consortium performance criteria for qualified screw-in or pin-based LED lamps.
2. Shall have Lamp CCTs conforming to ANSI C78.377A color binning and utilize a 3 step MacAdam Ellipse Algorithm binning process (Philips Optibin or equal) within each retrofit lamp for greater CCT consistency.
3. The CCT shall be 3000K unless otherwise stated. The CCT between the same product shall not vary more than 100K. The CRI shall be ≥80.
4. Each lamp shall have a power factor ≥90%.
5. Each lamp shall have total harmonic distortion (THD) <10%
6. Shall be tested in accordance with LM-79-08 electrical and photometric measurements.
7. Shall be tested in accordance with LM-80 lumen depreciation test. The L70 rated life result shall be a minimum of 25,000 hours for MR16 and candelabra lamps; 40,000 hours for PAR 20, 30, 38 and BR30 lamps.
8. Shall carry a 3 year minimum product warranty covering failure of all electrical components.

F. Luminaires

1. The luminaire manufacturer shall be registered as a DOE Quality Advocate.

2. Shall meet DOE's Energy Star or Design Light Consortium performance criteria
3. The luminaire manufacturer shall provide the manufacturer's name of the LED being used in the luminaire.
4. Shall be UL, or ETL, listed and be furnished complete with LEDs and power supplies.
5. LED light source packages, arrays or modules used in the luminaire shall be tested in accordance with LM-80 lumen depreciation test. The L70 rated life result shall be a minimum of 50,000 hours.
6. Shall be tested in accordance with LM-79-08 electrical and photometric measurements.
7. The CCT shall be 3000K unless otherwise specified. The CRI shall be ≥80 unless otherwise specified.
8. Each luminaire shall have a power factor ≥90%.
9. In instances where the LED sources are to be mounted directly into the architecture, such as installing a strip LED by using an adhesive tape, the LED manufacturer shall provide a recommended heat sink volume adequate to achieve rated life at L70.
10. Each luminaire shall carry a 3 year minimum product warranty covering failure of ALL electrical components.
11. All luminaires shall be within a 2-step MacAdam Ellipses on the black-body curve, unless otherwise specified.

G. Power Supplies

1. LED power supplies shall operate LEDs within the current limit and voltage specification of the manufacturer.
2. Shall operate from 60Hz input source and have input power factor >90% and a minimum efficiency of 70% at full rated load of the driver.
3. Shall have short circuit and overload protection.
4. Shall have a minimum starting temperature of 0°F and a maximum case temperature rating of at least 70°C.
5. Power supply output shall be regulated to +/-5% across published load range.
6. Shall have a Class A sound rating.
7. Shall comply with the requirements of the Federal Communications Commission (FCC) rules and regulations, Title 47CFR part 15, non-consumer (Class A) for EMI/RFI.
8. Shall contain no PCBs.
9. Shall carry a five (5) year minimum warranty from date of Substantial Completion against defects in material or workmanship, including a replacement, for operation at or below the maximum case temperature specification. (For LED lamps and internal power regulation components for defects resulting in a fixture lumen depreciation >30%.)
10. Dimmable power supplies shall allow continuous, flicker-free dimming through entire listed range of light output.

2.4 LOW VOLTAGE LIGHTING

A. Where remote transformers are specified, transformers must be installed in accessible areas large enough to dissipate the heat of the transformer. Temperatures should not exceed 100 degrees Fahrenheit (38 degrees Celsius).
B. Transformers shall be rated for operation on the electrical system voltage to which they are shown connected.
C. Transformers should be mounted as close to the feed lampholders as practical to keep the secondary feed as short as possible.
D. Low voltage transformers shall be fused on the primary and secondary side with protection devices sized as appropriate to conductors, lamps, and transformers.

E. Contractor is responsible to lay out and install low voltage systems to prevent excessive light loss due to voltage drop.
F. Contractor to install the system to meet local codes.

2.5 SPECIALTY FIXTURES

A. GENERAL:
1. Specialty Fixtures include fixture types FD1y, FD2y, PL3, PL4, WD7y, WD8y, and WD9y
2. Acceptable and acceptable alternate manufacturers are included in the Light Fixture Schedule. Substitutions are not permitted.
3. Manufacturer for fixture types PL3 and PL4 must supply a 24” working sample with plug and cord for purposes of a design/client team review and complete shop drawings to design team for review for bid. Sample fixtures will become property of the Client or their design team.
4. Fixtures and components shall meet UL or ETL requirements for use in their proposed location.
5. Manufacturers must provide heat testing data to confirm UL or ETL ventilation requirements.
6. Exposed hardware shall be concealed from view below, except where noted.
7. Acceptable manufacturers are listed in the fixture schedule and deviation from those listed will not be accepted.
8. Materials, accessories and other related fixture parts shall be new and free of any defects which in any manner may impair their character, appearance, strength or ability and function effectively protected from damage or injury from the time of fabrication until final acceptance of work.
9. Aluminum extrusions shall be free from tool marks, and dents and shall have accurate angles as sharp as compatible with the gauge of the required metal. Intersections and joints shall be formed true of adequate strength and structural rigidity to prevent distortion after assembly.
10. Housing shall be so constructed that drivers and LED module, electrical components are easily accessible and replaceable from above, without removing fixtures from their mountings or disassembly of adjacent construction.
11. Fixtures shall be completely wired at the factory. Fixtures shall come with electrical wire whips in accordance with local codes and in accordance with actual installation requirements.
12. Leaks within fixtures and between fixtures and mounting surface will not be tolerated.
13. Steel and aluminum fixtures, screws, bolts, nuts and other fastening and latching hardware shall be cadmium or equivalent plated. For stainless steel fixtures, hardware shall be stainless steel or bronze. Fixtures must be assembled and gasketed properly to prevent galvanic action.

B. FIXTURE DESCRIPTIONS:
1. FD1y
   a. Shall be a surface ceiling mounted fixture.
   b. The dimensions shall be 36” diameter and approximately 12” depth.
   c. The acrylic bowl shall be nominally 20” diameter, with a minimal finial in the center.
   d. The fixture detailing shall match the fixture drawing in cut sheets.
   e. An array of carved and cast detail indicating Black-eyed Susan motif surround the glass bowl.
   f. There will be minimal set screws to fasten the components, finished to match the metal.
   g. No other hardware will be visible from the front or side view of the fixture.

h. The metal shall be brass construction, with a standard patina finish, selected by architect. Samples of finishes shall be provided upon request.
i. Drawing and rendering /sample of the proposed leaf pattern shall be submitted with bid.
j. Lamping shall be (10) medium base sockets to house a dimmable 8 watt LED A19 frosted lamp, as shown on light fixture schedule.
k. Lamps must be rated for use in an enclosed fixture. Corncob type or substitute LED retrofit lamps are not acceptable.
l. Manufacturer to provide a maintenance directive for access to the lamps as part of the Operations and Maintenance Manual.

2. FD2
   a. Shall be a surface ceiling mounted fixture.
   b. The dimensions shall be 60” diameter and approximately 18” depth.
   c. The acrylic bowl shall be nominally 35” diameter, with a minimal finial in the center.
   d. The fixture detailing shall match the fixture drawing in cut sheets.
   e. An array of carved and cast detail indicating Black-eyed Susan motif surround the glass bowl.
   f. There will be minimal set screws to fasten the components, finished to match the metal.
   g. No other hardware will be visible from the front or side view of the fixture.
   h. The metal shall be brass construction, with a standard patina finish, selected by architect. Samples of finishes shall be provided upon request.
   i. This fixture will be located under a covered portico on the exterior of the building. The fixture shall be wet location listed suitable for mounting condition.
   j. There shall be a double bowl configuration to prevent visible insect and dirt build up into the bowl and other components.
   k. The mounting plate shall be sloped at edges to discourage bird nesting.
   l. Lamping shall be (16) medium base sockets to house a dimmable 8 watt LED A19 frosted lamp, as shown on light fixture schedule. Corncob type or substitute LED retrofit lamps are not acceptable.
   m. Manufacturer to provide a maintenance directive for access to the lamps as part of the Operations and Maintenance Manual.

3. PL3
   a. Shall be a continuous suspended extruded aluminum ring, nominally 18’-0” diameter, with a section profile of 7.5” x 2.25”.
   b. The ring shall be powder coated painted a RAL color selected by Architect. Samples of finishes shall be provided upon request.
   c. The ring shall be suspended by (12) shrouded stainless steel cables equally pitched and vertically adjustable from 0’-8” to 1’-6”.
   d. The ring shall have one single power feed and 2 conductor control cables for DALI-2 control signal.
   e. Power shall be 350mA from integral EldoLED DALI-2 drivers, providing 0.1% dimming and individual control of each head.
   f. Power feed shall be shrouded in painted tube, finish to be an RAL powder coat selected by architect.
   g. Housing shall support (24) adjustable accent light fittings, each with 11.9 watt, Xicato XOB 9.8mm in 3000k, 90CRI LED sources, evenly pitched throughout the ring.
   h. Each accent light shall be a round 3.25” housing, adjust 45 degrees from nadir, 360 degree rotation and lock both adjustments using hex head set screw accessible from the front of the fitting and deliver approximately 1,000 lumens.
   i. Each accent light shall have a maximum of 10-18 degree beam with the following field interchangeable optics: 25-30 and 30-40 degrees.
   j. Each head shall be provided with a hexcell louver accessory lens.

4. PL4
   a. Shall be a continuous suspended extruded aluminum frame, nominally 52'-8" x 32'-2" rectangle, with a section profile of 7.5" x 2.25".
   b. The frame shall be powder coated painted a RAL color selected by Architect. Samples of finishes shall be provided upon request.
   c. The frame shall be suspended by (36) shrouded stainless steel cables equally pitched. Cables shall be capable of adjust length vertically on site from 0'-8" to 1'-6".
   d. The frame shall have one single power feed and 2 conductor control cables for DALI-2 control signal.
   e. Power shall be 350mA from an integral EldoLED DALI-2 drivers, providing 0.1% dimming and individual control.
   f. Power feed shall be shrouded in painted tube, finish to be an RAL powder coat.
   g. Housing shall support (69) adjustable accent light fittings, each with 11.9 watt, Xicato XOB 9.8mm in 3000k, 90CRI LED sources, evenly pitched throughout the frame.
   h. Each accent light shall be a round 3.25" housing, adjust 45 degrees from nadir, 360-degree rotation and lock both adjustments using hex head set screw accessible from the front of the fitting and deliver 1,000 lumens.
   i. Fixture heads shall have an accessory holder to house up to two accessories.
   j. Type A Heads:
      1) Fixture will have (55) type A heads with a 10-18 degree beam
      2) Provide a linear spread accessory lens and lightly frosted accessory lens per head.
   k. Type B Heads:
      1) Fixture will have (14) type B heads with a 10-18 degree optic with the following field interchangeable optics: 25-30, 30-40 degrees.
      2) Provide a hexcell louver accessory lens per head.
5. WD7y
   a. Shall be a two headed globe sconce mounted on a rectangular backplate.
   b. The dimensions shall be 29" height, 20" wide and 10" projection.
   c. The fixture detailing shall match the fixture drawing in cut sheets.
   d. Maximum of (8) hex screws on the back plate, finished to match the backplate.
   e. There will be small set screws to fasten the globe to the arm, finished to match.
   f. No other hardware will be visible from the front or side view of the fixture.
   g. The metal shall be brass construction, with a standard patina finish, selected by architect. Samples of finishes shall be provided upon request.
   h. The lens shall be white opal acrylic.
   i. Fixture shall be controlled by dimming control system capable of dimming to a maximum of 10% light output.
   j. The medium base socket shall house a dimmable 8 watt LED A19/3000k lamp, delivering approximately 800 lumens. Corncob type or substitute lamps are not acceptable.
   k. The globe must be removable in the field to access the lamp for maintenance.
6. WD8y
   a. Shall be a single headed globe sconce mounted on a rectangular backplate, suitable for wet location, exterior conditions where in direct exposure to the elements.
   b. The fixture detailing shall match the fixture drawing in cut sheets.
   c. The dimensions shall be nominally 30" height, 16" wide with 24" projection.
   d. There will be a maximum of (2) ball screws on the back plate, finished to match the backplate.
   e. There will be small set screws to fasten the globe onto the arm, finished to match.
   f. No other hardware will be visible from the front or side view of the fixture.

g. The metal shall be brass construction, with a standard patina finish, selected by architect. Samples of finishes shall be provided upon request.
h. The lens shall be a white opal acrylic.
i. Fixture shall be controlled by dimming control system capable of dimming to a maximum of 10% light output.
j. The medium base socket shall house a dimmable 8 watt LED A19/3000k lamp, delivering approximately 800 lumens. Corncob type or substitute lamps are not acceptable.
k. The globe must be removable in the field to access the lamp for maintenance.

7. WD9y
   a. Shall be a single headed sconce mounted on a rectangular backplate.
   b. The dimensions shall be 29” height, 8” wide and 10” projection.
   c. The fixture detailing shall match the fixture drawing in cut sheets.
   d. Maximum of (4) hex screws on the back plate, finished to match the backplate.
   e. There will be small set screws to fasten the globe to the arm, finished to match.
   f. No other hardware will be visible from the front or side view of the fixture.
   g. The metal shall be brass construction, with a standard patina finish, selected by architect. Samples of finishes shall be provided upon request.
   h. The lens shall be a white opal acrylic.
   i. Fixture shall be controlled by dimming control system capable of dimming to a maximum of 10% light output.
   j. The medium base socket shall house a dimmable 8 watt LED A19/3000k lamp, delivering approximately 800 lumens. Corncob type or substitute lamps are not acceptable.
   k. The globe must be removable in the field to access the lamp for maintenance.

2.6 SUSPENDED FIXTURES

A. Where fixtures are mounted in a continuous row, fixtures eight feet in length shall have stems placed within 2 feet of fixture ends. Stems shall be spaced symmetrically. A fixture four feet or three feet in length, placed in rows shall have a stem connected to the center fixture.
B. Suspended fixtures shall be stem-mounted and shall be free to swing 20 degrees in any direction. Ceiling swivels shall be of the ball aligner type permitted on the drawings. Chain suspension may be used only where specifically permitted on the drawings. Chain shall be heavy duty, nickel-plated suitable for the weight of specific fixtures.
C. Provide redundant support for pendant-mounted fixtures.

2.7 TRACK

A. Contractor to assemble track fixtures and accessories prior to installation.
B. Contractor will supply necessary connectors and adapters and necessary mounting and electrical feed equipment.
C. Contractor to mount fixtures to track. Final aiming to be done with the guidance of the Lighting Consultant.

2.8 ACCESSORIES & LENSES

A. Plastic used for lenses and diffusers shall be formed of colorless 100% virgin acrylic as manufactured by Rohm & Haas, DuPont, or acceptable equal, unless otherwise noted.

B. Glass used for lenses, reflectors, diffusers, and luminaires shall be tempered for high impact and heat resistance. The glass shall have a transmittance of not less than 88%, unless otherwise indicated. For exterior luminaire use tempered borosilicate glass Corning #7740 or acceptable equal.
C. Lenses, louvers, and other light diffusing elements shall be removable and positively held so that hinging or other normal motion will not cause them to drop out.
D. Lenses shall be turned over to the Owner clean and free of dust or finger prints.
E. Spread lenses shall be provided with notches or locking devices to insure that lens orientation is not disturbed during luminaire lamp replacement or cleaning.

2.9 LAMPS

A. Provide lamps as indicated on the luminaire schedule and the applicable contract documents.
B. Lamps of a given type shall be produced by one manufacturer.
C. Provide 10% spare lamps for fixtures.
D. Lamps used in food preparation areas and not protected by a suitable lens diffuser shall be fully protected with Teflon coating, tube guards, or other means as required by the N.E.C. Teflon coating shall be as provided by Shatter-Shield or equal.
E. LED retrofit lamps shall be 120V unless otherwise specified.
F. Provide rough service lamps for fixtures located in plenum air chambers and elevator or escalator pits.

2.10 EMERGENCY LIGHTING

A. Refer to Division 26.

2.11 EXIT SIGNS

A. Refer to Division 26.

2.12 LIGHTING CONTROLS

A. Refer to Division 26.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Provide luminaires at locations, and of types, as indicated on the contract drawings.
B. Contractor shall be responsible for coordinating with the other trades to ensure and maintain adequate recess clearance as lighting positions are critical and shall take precedence over other concealed building systems.
C. Contractor shall be responsible for installing fixtures with proper ventilation so as not to exceed the temperature rating of the lighting fixtures or lamps.
D. Notify the Architect about field conditions at variance with plans and/or specifications before commencing installation. Failure to do so shall exonerate the Architect from responsibility for

problems resulting from same, and work required to correct the discrepancy shall be performed by the Contractor with no additional compensation.

E. Prior to ordering lighting equipment, the Contractor shall verify locations and recess depths, final voltages, and ceiling trims compatibility. Additional charges for failure to verify locations will not be allowed.

F. Plaster frames for recessed fixtures shall be installed in a rigid manner so as not to allow fixture frame or housing to move or shift when trim is removed or fixture is re-lamped.

G. For bracket-mounted fixtures, provide metal plate attached to outlet box with threaded holes suitable for supporting the fixture rigidly in design position. Studs shall be steel or malleable iron, and galvanized. Die cast studs shall not be used. Electrical boxes shall be securely mounted and not move in the wall or shall be reset and wall refinished at the Contractor's expense.

H. Where required by the local building or health department, provide approved wire guards and or plastic sleeves over fixtures.

I. Install luminaires properly and safely. Provide hangers, rods, mounting brackets, supports, frames, yokes, support bars and other equipment required for a complete installation.

J. Luminaires shall be complete with lamps of the type noted in the schedules and shall have metal parts, glassware, plastic diffusers etc., free from scratches, cracks, and other defects. Items damaged during shipment handling, or installation shall be replaced without expense to the Owner.

K. Parabolic fixture care: Parabolic fixtures to be installed with Mylar cover shall be U.L. listed for temporary lighting. Upon completion of work, remove Mylar cover with white gloves and assure louvers are free from dust and fingerprints.

L. Fixtures installed with plastic lenses shall be cleaned and de-staticized after installation. Install and leave with no fingerprints or dirt marks on the lens or diffuser. Use white gloves if necessary.

M. Lamps must be operational at time of turn over to the owner.

N. Luminaires to be cleaned prior to opening the facility.

O. Luminaires shall be packaged with complete instructions and illustrations showing proper installation procedures. Install luminaires in strict conformance with manufacturer's recommendation and instructions.

P. Contractor is required to protect fixtures from damage during installation and up to time of acceptance by the Architect. Broken fixtures, glassware, plastics, lamps etc. must be replaced by the Contractor with new parts without expense to the owner.

Q. Whenever a luminaire is operated as a work light during construction it shall be re-lamped with the project-specified lamp just prior to turnover of the area to the owner.

R. Fixtures shall be installed so that no labels will be visible under normal operating conditions of the fixture.

S. If fixtures are installed in a fire rated ceiling, the Contractor will preserve the fire rating according to the UL assembly number.

T. Light poles shall be grouted to fill the space between the pole base plate and the concrete base.

U. Install lamps in fixtures.

V. Wall slot fixtures are to be installed prior to the finishing of walls where they are found. They are to be used as the sole work light when finishing the adjacent wall.

W. When multiple fixtures of a given voltage are mounted in trees, power shall be provided from base of tree to junction box on tree strap in tree canopy (or at base of bulb for palm trees) through single exterior grade MC cable with black coating.

X. Matte white face plates for pinhole and slot downlights shall be painted prior to installation to match the soffit in which each is to be located.

Y. Remote ballasts and transformers shall be concealed in dry, accessible locations unless otherwise directed.

Z. All lamps requiring burn in shall be burned in per individual lamp manufacturer's recommendation by Contractor, or they shall be provided pre-seasoned.

3.2 AIMING AND ADJUSTMENTS

A. Adjustable lighting units shall be aimed, focused, and locked, etc., by the Contractor under the supervision of the Design Team and at the discretion of the Design Team.
B. Aiming and adjustments shall be carried out after installation is complete and at least 5 business days in advance of the project completion date in order to schedule the fixture focusing sessions. Ladders, lifts, scaffolding, and/or other means of accessing all light fixtures shall be furnished by the Contractor at the direction of the Design Team. As aiming and adjusting is completed, locking set screws, bolts, and nuts shall be tightened securely.
C. During aiming and adjusting the units, the Contractor shall provide

1. Tools for unlocking, locking, and/or adjusting fixtures as required, along with gloves suitable for handling the hot lamps.
2. All specified accessory lenses, interchangeable optics, and other components (either installed or on hand as directed in the lighting fixture schedule).
3. Correct lamps installed.
4. Spare lamps as required to replace any burned out lamps

D. The Contractor shall coordinate with the other trades and the Owner to ensure that light fixtures to be aimed are accessible.
E. The Contractor shall coordinate with the other trades and the Owner to ensure that focusing sessions are schedules during times when all of the light fixtures can be turned off/on during the entire duration of the sessions. Individual circuits shall have the ability to be turned on/off independently of the other lighting circuits.
F. Where possible, units shall be focused during normal working daytime hours. However, where daylighting interferes with aiming and focusing, the aiming shall be performed after sunset.
G. A portion of the lamps remaining after the final aiming will be turned over to the owner for stock; while the others shall be returned unopened to the contractor’s distributor for full credit to the Owner.

3.3 COORDINATION WITH AMBIENT CONDITIONS

A. The Contractor is responsible for coordinating the characteristics and the U.L. labeling of the luminaires and their components with the ambient conditions which will exist when the luminaires are installed. These areas of coordination include, but are not limited to, the following:

1. Wet location labels.
2. Damp location labels.
3. Low temperature ballasts.
4. Dimming ballasts.
5. Very low heat rise ballasts.
6. Plenums and air handling spaces.
7. Fire rated ceilings.
8. Low density ceiling.
9. Insulated ceilings.

PART 4 - LIGHT FIXTURE CUT SHEETS

END OF SECTION

This page is intentionally left blank.

SECTION 26 56 13 - POLES AND STANDARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work of this section.

B. Division 26 Basic Electrical Materials and Methods sections apply to work specified in this section.

1.2 SUMMARY

A. The section includes not limited erecting, trenching and installation of poles and standards.

B. Applications of lighting poles and standards specified in this section include the following:

1. Automobile parking lots.
2. Pedestrian walkways.
3. Building entrances.

C. Related Sections: The following sections contain requirements that relate to this section:

1. Division 31 Section, “Earthwork” for excavation and backfilling of poles, standards, and foundations are specified in Division 2.
2. Division 3 Section, “Concrete” for embedding poles, and for pole foundations.
3. Wires/cables, raceways, and electrical boxes and fittings which are required in connection with electrical poles and standards are specified in Division 26.
4. Exterior lighting fixtures (luminaries) and brackets which are required in connection with electrical poles and standards are specified in another Division 26 section, “Lighting Fixtures”.

1.3 SUBMITTALS

Submit shop drawings, samples, and prototypes as specifically instructed herein and as follows:

A. Shop drawings shall include but not be limited to:

1. Submit fixture shop drawings in booklet form with a separate sheet for each fixture, assembled in “luminaire type” alphabetical or numerical order, with proposed fixture and accessories clearly indicated on each sheet.
2. Manufacturer’s dimensioned scale drawings showing in complete detail, the fabrication of all electrical pole standards, arms, and hardware including overall and detail dimensions, finishes, metal thickness, type, fabrication methods, support method, ballasts, hinges, gaskets, wind loading, wire/cable connections, and all other information to show compliance with the Contract Documents.

B. Samples

1. Partial pole standards samples may be requested for any or all of the fixtures specified.
2. Submit for approval samples called for by the Engineer when and where directed, and the components tagged with the name of the project. Samples will not be returned. Allow two weeks from the date of receipt for thorough examination and review by the Architect and Engineer.
3. All samples require a submission of material finish samples and component approval to be reviewed prior to shipment of any material to the project.
4. Electrical pole standards under the contract shall be identical with the approved sample. No portions or parts of the electrical pole standard used as a sample will be allowed to be installed on the project.
5. In the event the submissions are disapproved, the samples will be returned to the Contractor to immediately make a new submission of electrical pole standards meeting the contract requirements.
6. All costs associated for samples are to be paid by the Contractor. No additional cost to the owner for samples will be allowed.

C. Wiring Diagrams: Submit wiring diagrams for electrical poles and standards showing connections to electrical power panel feeders, switches, and controllers. Differentiate between portions of electrical wiring which are manufacturer-installed and portions which are field-installed.

D. Shop drawings and samples requested shall be submitted for approval before fabrication. Any material produced prior to the approval of shop drawings or samples, and not in conformance with the Contract Documents, shall be disapproved with the Contractor bearing full responsibility and cost.

E. No variation from the general arrangement and details indicated on the drawings shall be made on the shop drawings unless required to suit the actual conditions on the premises, and then only with the written acceptance of the Architect. All variations must be clearly marked as such on the drawings submitted for approval.

F. Manufacturers not listed must be pre-qualified prior to bid. For approval of all electrical pole standards substitutions, the fabricator shall comply to specifications herein and as outlined below:

1. Manufacturer shall have not less than 5 years experience in design and manufacture of pole standards on the type and quality shown. Pre-qualification submissions must include a list of completed projects and dated catalogue pages and drawings indicating length of experience.
2. Manufacturer shall also submit a partial prototype sample of each pole standard for review by the Architect and Engineer. Prototype samples shall be sufficiently detailed to allow evaluation of compliance with the salient features of the specification. Preliminary design or shop drawings shall not be accepted in place of prototype samples.
3. Printed physical, electrical and technical data clearly highlighted to show the differences between the proposed substitutions and the specified electrical pole standards.
4. The Architect and Engineer shall determine whether the prototype sample complies with the specifications and shall reserve the right to disqualify any bidders.

1.4 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of electrical poles and standards of types and sizes required, whose products have been satisfactorily used in similar service for not less than 5 years.

B. Installer's Qualifications: Firms with at least 5 years of successful installation experience with projects utilizing electrical pole and standard work similar to that required for this project.

C. Codes and Standards:

1. Electrical Code Compliance: Comply with applicable local code requirement of the authority having jurisdiction and NEC Articles 220, 225, 250, 410, and 501 as applicable to installation, and construction of electrical poles and standards.
2. UL Compliance: Comply with UL standards, including UL 486A and 486B, pertaining to electrical poles and standards. Provide lighting components and fittings which are UL-listed and labeled.
3. ANSI/ASTM Compliance: Comply with applicable requirements of ANSI C 2, "National Electrical Safety Code", pertaining to construction and installation of lighting poles and standards.
4. AASHTO Compliance: Comply with applicable requirements of American Association of State Highway and Transportation Officials Standard LTS-1; "Standard Specifications for Structural Supports for Highway Signs, Luminaries and Traffic Signals".
5. NEMA Compliance: Comply with NEMA Standards Pub/No's. LE 2 and TT 1 pertaining to electrical pole and standard units, materials, and installation.
6. IES Compliance: Comply with applicable requirements of IES RP-8, "Roadway Lighting", and RP-20, "Parking Facilities Lighting".

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Deliver electrical pole and standard products, and fittings in factory-fabricated containers or wrapping, which properly protect products from damage.

B. Store electrical pole and standard products and fittings in original cartons in well-ventilated space protected from moisture, construction traffic and debris.

C. Handle electrical pole and standard products carefully to prevent breakage, denting and scoring finish. Do not install damaged units or components; replace with new.

1.6 SEQUENCING AND SCHEDULING

A. Coordinate with other electrical work including wires/cables, electrical boxes and fittings, and raceways, to properly interface installation of electrical pole and standard work with other work.

B. Sequence electrical pole and standard installation work with other work to minimize possibility of damage and soiling during remainder of construction period.

PART 2 - PRODUCTS

2.1 ELECTRICAL POLE STANDARDS

A. Metal Lighting Standards: Provide metal, raceway-type, lighting poles and standards, of sizes and types shown on schedules, comprised of shafts and tenon joints. Equip with grounding connections readily accessible from handhole or transformer base access doors; and constructed of the following materials and additional construction features:

1. Material: Cast aluminum for pedestrian scale poles, unless otherwise noted. Steel poles for parking lots and roadways, unless otherwise noted.
2. Configuration: Anchor base type with hand hole and cover where indicated.
3. Configuration: Transformer base type with access door and cover.
4. Metal Lighting Standard Accessories: Provide accessories for metal lighting standards, including anchor bolts, anchor bolt cover, as recommended by lighting standard manufacturer, of sizes and materials needed to meet erection and loading application requirements.

B. Pole base shall be designed by a professional structural engineer licensed in the state of Maryland who is hired by the contractor / manufacturer to ensure pole base meets AASHTO requirements for the geographical project location.

C. Provide vibration dampener field or factory installed. Dampener shall be serpentine type, chain type are not permitted. Dampener shall be provided for the following types of poles:

1. Round Poles.
2. Square Poles.
3. Tapered Poles over 25 feet.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions under which pole standard, equipment and components are to be installed, and substrate which will support equipment. Notify Engineer in writing of conditions detrimental to proper completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF ROADWAY AND PARKING AREA LIGHTING

A. Install pole and standard units and products in accordance with manufacturer’s written instructions, applicable requirements of NEC, NESC and NEMA standards, and with recognized industry practices to ensure that roadway and parking area lighting equipment fulfill requirements.

B. Utilize belt slings or rope (not chain or cable) to protect finishes when raising and setting finished poles and standards.

C. Set poles and standards plumb. Support adequately during backfilling, or when anchoring them to the foundations.

D. Provide sufficient space encompassing hand access and cable entrance holes for installation of underground cabling and conduit.

E. Fasten electrical lighting fixtures and brackets securely to structural supports, including poles/standards; and ensure that installed fixtures are plum and level.

F. Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for equipment connectors. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL Standards 486A and 486B, and the National Electrical Code.

3.3 GROUNDING

A. Provide equipment grounding connections for poles and standards. Provide a ¾" x 10' copper rod at each pedestrian, parking lot and street lighting pole. Connect to a #6 bare copper ground wire. Tighten connections to comply with tightening torques specified in UL 486A to assure permanent and effective grounding.

END OF SECTION

This page is intentionally left blank.

SECTION 26 90 00 - PROJECT CLOSEOUT

PART 1 - GENERAL

1.1 WORK INCLUDED

A. The contractor shall summarize and document adherence with the requirements of the specifications for project closeout including:

1. Copies of all warranties
2. Operation & Maintenance Manuals
3. Required tests
4. Certifications
5. Record drawings
6. Permit requirements

B. The contractor shall compile a closeout manual which shall include:

1. A list of all required tests and a place for signoff of date completed.
2. A list of all submittals with dates of acceptance by the engineer.
3. A schedule indicating dates for beginning testing and startup of equipment and dates of tests to be witnessed by the engineer, or designated representative, as required by the specifications.
4. Test procedures to be used for life safety systems.
5. Project close out check list.

C. The final closeout manual shall include the following:

1. Test reports as required by the specifications with signoff by the appropriate individual (engineer, architect, building official, etc.).
2. Documentation indicating all equipment is operating properly and is fully accessible for maintenance.
3. Copies of all warranties.

D. This section only includes the requirements for documentation of the contract documents, by the contractor, for project completion. This section does not in any way decrease the scope of any of the drawings or specifications.

1.2 SUBMITTALS

A. Within 90 days after notice to proceed submit a preliminary closeout manual with the following:

1. A list of all required tests.
2. Preliminary schedule showing major milestones for completion of the electrical and technology systems.

B. Within 30 days of the first major milestone submit the completed closeout manual as described in Part 1.

C. Within 2 weeks of substantial completion submit a completed “Project Closeout Check List”, and the Final Closeout Manual.

D. Listed below is a checklist for use by the contractor. This list is not all inclusive for this project.

Project Close-Out Summary - Electrical

- ☐ The following tests have been completed. Submit test report for record.
  - ☐ Feeder Testing and Reporting (Megger Result)
  - ☐ Transformers Testing and Reporting
  - ☐ Grounding System Testing and Reporting
  - ☐ Generator Testing and Reporting
  - ☐ Infrared Scans, Testing and Reporting
- ☐ All main components of the electrical system cleaned and vacuumed. This includes unit substations, switchboards, distribution boards, panel boards, etc. Provide ME Engineers with schedule when this is going to occur and a letter stating it has been completed.
- ☐ The contractor shall schedule a walk through with the engineer to inspect all feeder sizes. Covers for panel boards and distribution boards should be removed by the contractor for visual inspection of feeder sizes.
- ☐ Temporary cable tray hooks inspected.
- ☐ The fire alarm system manufacturer shall provide the Owner/Architect with a “Letter of Certification” indicating the system is fully functional and meets all manufacturers requirements as well as code and design requirements. Fire department must sign off the system.
- ☐ Provide spare fuses and fuse cabinets ((1) in each switch gear room) per specifications.
- ☐ Panelboard directories completed with typed print outs.
- ☐ Record drawings submitted.
- ☐ All lighting control systems complete with controls fully operational for visual inspections.
- ☐ Adjustable Lighting fixtures have been aimed with design team per specification 26 51 00.
- ☐ The lightning protection system manufacturer shall provide the Owner/Architect with a “Letter of Certification” indicating the system meets all manufacturers requirements as well as code and design requirements.

PART 2 - PRODUCTS – NOT USED

PART 3 - EXECUTION

3.1 EQUIPMENT STARTUP AND TESTING

A. Prior to completion and punch list by the engineer, the contractor shall startup and test each piece of equipment as required by the specifications. The contractor shall provide documentation of all required tests with signoff of by the appropriate individual (engineer, architect, and building official).

3.2 LIFE SAFETY SYSTEMS

A. All life safety systems shall be fully and successfully tested by the contractor before being witnessed by the engineer or building official.

B. The contractor shall provide a detailed test procedure, with instrumentation to be used, for approval by the engineer and building official prior to any testing.

C. Once tested by the contractor and fully operation the systems shall be demonstrated to the engineer. Once accepted by the engineer the system shall be demonstrated to the building and fire officials.

3.3 COORDINATION WITH OTHERS

A. The Division 26 contractor shall coordinate their requirements with the general contractor to ensure the other building systems are completed to the point that they will not adversely affect the operation of any systems.

3.4 PUNCH LISTS

A. The contractor shall submit in writing that the project is ready for final review by the engineer.

B. Once the project is ready for final review the engineer will create a punch list of any corrections or deficiencies.

C. The contractor shall complete all punch list items and provide a letter to the architect after completion stating all items have been completed or reasons why they were not completed.

D. Upon receipt of this letter the engineer will verify that the punch list has been satisfactorily completed.

END OF SECTION

This page is intentionally left blank.

SECTION 27 05 00 - COMMON WORK RESULTS FOR COMMUNICATIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Product Appendix: Refer to Appendix 1, Equipment Schedules at the end of each specification section for specific product information on the benchmark products. These equipment schedules should be the baseline for product data submittals but are not intended to be an all-encompassing bill of materials, unless noted otherwise.

B. Part 1 and Part 3 of this specification applies to all Division 27 specification sections.

C. General provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections.

D. Architectural, Electrical, and Technology Drawings. Other systems drawings may apply.

E. Division 26 Specifications. Coordinate Electrical System requirements. Basic Electrical Materials and Methods sections apply to work of this section.

F. Division 27 Specifications. Provide requirements in all corresponding Division 27 Communications Specifications.

G. Division 28 Specifications. Coordinate Security System requirements.

H. Vertical Transportation (Elevators, Escalators, etc.) Specifications and/or Codes Requirements.

I. Rough carpentry is specified in a Division 6 section.

1.2 SUMMARY

A. Project Expectations: Within two weeks after award of contract, the Contractor shall arrange a “CA kickoff” meeting and/or conference call with the General Contractor, Construction Manager, Architect, Engineer, and Owner (when applicable) to discuss general project expectations.

B. The term, “provide” used throughout this specification and drawings shall mean “furnish, install, test, and certify”.

C. Coordinate project schedule, installation schedule, phasing and any other requirements deemed necessary with Construction Manager and/or General Contractor and all necessary trades to ensure successful completion of work.

D. Phasing, temporary distribution/equipment, cut-over and implementation shall be coordinated with Owner, Construction Manager and/or General Contractor, Architect, and Engineer.

E. Extent of communications infrastructure work is indicated by Division 27 specifications and Technology drawings and schedules and is hereby defined to include, but not by way of limitation, the provisions of:

1. Raceway systems including but not limited to conduits, cable trays, sleeves, surface raceways, telecommunication services entrance, manholes, hand holes, pull-boxes, junction boxes, back-boxes, etc. as required and specified in Division 27 sections and/or select Division 26 sections. The Construction Manager and/or General Contractor shall coordinate this with the Sub-Contractor performing work and determine how scope of work is assigned. The purpose of this specification is to establish design intent and general system scope.
2. All communications infrastructure shall be provided as part of the Base Building Project including but not limited to raceway, cable, cable terminals, and comm room fit-out.
3. Backbone cables between the Main Cross-connect (MC) and each Intermediate Cross-connect (IC) or Remote Hub location. Refer to Technology Drawings (one-lines and floor plans) for specific locations and sizes.
4. Horizontal or station cables between each communication device outlet and the nearest Intermediate Cross-connect (IC) or remote hub location.
5. Backbone and horizontal cable termination and terminals including but not limited to wiring panels/blocks, patch panels, fiber optic terminals and panels, and outlets/jacks.
6. Patch cords, jumper cables, and cross-connect cables (unless specifically excluded in 27 13 13, 27 13 23, or 27 15 00) to interconnect wiring terminals as well as electronic equipment.
7. Communication room hardware and component fit-out including cabinets, racks, cable tray, backboard, and raceways for terminating cable and installation of electronic equipment.
8. Power distribution within equipment racks and cabinets including power strips (unless specifically excluded in 27 11 00).
9. Grounding and bonding of all metallic hardware components to the nearest telecommunications grounding bus (TGB) bar including but not limited to equipment racks, cabinets, cable trays, ladder rack, metallic cable sheaths, wall mounted wiring terminals, conduits, sleeves, metallic ductwork, and frames.
10. All physical cable management hardware including, but not limited to: “J-hooks” in accessible ceiling areas, “D-rings” on backboards, vertical and horizontal managers on racks and cabinets, vertical and horizontal ladder-type or wire basket cable tray within communication rooms, etc.
11. Fire stopping as required. Contractor shall provide fire stopping for all low-voltage openings (including empty low voltage raceway) once cable installation is complete. Contractor shall confirm specific fire stopping scope requirements with General Contractor and/or Construction Manager and shall verify that fire stopping materials and installation are in compliance with all applicable codes and listing requirements.
12. Seismic bracing of all equipment cabinets, equipment racks and ladder-type or wire basket cable tray as required by code and by local governing jurisdiction.
13. Testing of all communications cable infrastructure and grounding systems as noted by specification, drawings, and applicable industry standards.
14. Labeling of all communication infrastructure components, hardware, cable, and terminations with mechanically printed labels.
15. Preparation and submission of product data, shop drawings, testing reports, as-built drawings, and cabling documentation as required in this specification.
16. Construction and Installation warranties.
17. Manufacturer components, channel and solutions warranties.
18. Installation and testing of all system and components.
19. Onsite administrative and user training.
20. Manufacturer training of components.

F. Any discovered unsafe or noncompliant conditions of a proposed designated space shall be brought to the attention of JIS immediately and reconciled.

1.3 SUBMITTALS

A. General Description and Requirements

1. Refer to Product Data and Shop Drawing Submission Checklist (appendix) at the end of this specification section for additional requirements specific to each Division 27 section.
2. Contractor shall not submit product data for review without submitting corresponding shop drawings as part of the same submittal package. Partial submittals will be returned as “revise and resubmit”.
3. Submittal Schedule:

    a. Within 2-4 weeks after award of contract, the Contractor shall submit a proposed schedule for submitting product data and shop drawings. At a minimum, the following items shall be included:

        1) Submittal date for Compliance Matrix.
        2) Submittal date for Construction Schedule.
        3) Submittal date for Product Data and Shop Drawings.
        4) Submittal date for Commissioning and/or Test Results.
        5) Submittal date for As-Builts.

    b. Within 45 days after award of contract or as dictated by the construction schedule (whichever period of time is shorter), the Contractor shall submit prefabrication submittals consisting of product data and shop drawings for approval. Partial submittals will not be accepted without prior written approval from the Architect.

4. In addition to the requirements noted herein, refer to Division 1 Specification for additional requirements. As a minimum, Contractor shall ensure all requirements listed here are met.
5. Review of the Prefabrication Submittals by the Architect and Engineer is for purposes of tracking the work and contract administration and does not relieve the Contractor of responsibility for any deviation from the Contract Documents, or from providing equipment and/or services required by the Contract Documents which were omitted from the prefabrication submittals.
6. No portion of the project shall commence, nor shall any equipment be procured, until the prefabrication submittals (including product data and shop drawings) have been approved in writing by the Architect. All installations shall be in accordance with the Contract Documents.
7. A detailed completion schedule shall be submitted with the prefabrication submittals.
8. Prefabrication submittals shall be accompanied by a letter of transmittal identifying the name of the project, Contractor's name, date submitted for review, and a list of items transmitted.

B. Compliance Matrix:

1. Compliance Matrix: Provide a specification compliance matrix indicating compliance or deviation for each item in each and every Division 27 specification section. Refer to the SPECIFICATION RESPONSE section within this specification and Appendix 2 for additional requirements.

    a. General Notice: Provide a general notice for acceptance of all sections within this specification.
    b. Exceptions: Provide all exception to the specification listing:

        1) Specifications section reference
        2) Statement of exception
        3) Explanation of exception

    c. If the Contractor has no exception to the specifications, then provide a "No Exception Taken" statement.

C. Product Data:

1. Warranty Information: Provide all warranty information as described in this specification section for review and approval.
2. Component List: Provide complete submittal component list (i.e., parts table of contents) at the beginning of the submittal package for each specification section. Component list and manufacturer cut-sheets shall be compiled to match the order of Appendix 1 within each Division 27 section. Component list shall include and clearly identify the following for each part:

    a. Component name / description
    b. Manufacturer
    c. Specific product number (to clearly indicate special options, colors, etc.)

3. Cut-Sheets: Submit manufacturer's cut-sheets for all components listed within each specification section and corresponding appendix or required for a complete installation as specified. Cut sheets shall include and clearly identify the following for each part:

    a. Component name / description
    b. Manufacturer
    c. Specific product number highlighted in color to distinguish specific product/part numbers, options, colors, accessories, etc.
    d. Do not submit manufacturer's documentation or cut sheets for components that are not required for specified installation.

4. Product Substitutions: These specifications are intended to be performance based, except where specifically noted otherwise. Thus, all products listed in each respective Appendix 1: Equipment Schedules are "benchmark" products. The Contractor shall include products from one of the "pre-approved" manufacturers as noted in the Appendix. The Contractor may submit (as a proposed alternate solution) substitute manufacturers and models that may be more cost effective or readily available. All substitutions shall meet or exceed the minimum functional, physical, and technical specifications. Acceptance of such substitutions is at the discretion of the Owner, Architect, and Engineer. Additionally, the requirements of Division 1 Specifications shall apply and may supersede requirements noted herein.

D. Prefabrication Shop Drawings: (Refer to Appendix-3 for additional requirements)

1. General: All shop drawings shall be provided on contractor specific title block. Contractor may use Technology Drawing files as a “starting point” for shop drawings but additional information shall be added and/or updated as noted below.
2. Symbol Legend, Abbreviations, and Description: Drawings shall include the following:

    a. General project information, contractor company name, etc.
    b. Descriptions of all abbreviations and symbols
    c. Typical device mounting heights
    d. General notes and/or scope description, exclusions, etc.

3. One-Line Wiring Diagrams: Provide backbone raceway one-line, backbone and horizontal cabling, copper pair and fiber strand counts, cable quantities, splice enclosures, etc. Include conduit allocation and fill ratios for all conduits on the raceway one-line diagram.
4. Site Plan: Provide complete site and exterior plans indicating all site and building façade mounted communication device outlets, equipment, and components proposed to be installed. Additionally, manholes, hand holes, pull-boxes, and all major raceway routing shall be indicated for conduits 2-inches and larger. Shop drawings shall represent final conduit routing and manhole, hand hole and/or pull-box placement as coordinated and/or confirmed with Service Provider, Civil Engineer, and other trades.
5. Floor Plans:

    a. Floor plans shall indicate all communication device outlets, equipment, and components proposed to be installed.
    b. Floor plans shall indicate cable routing origin and labeling scheme for each cable and termination position.
    c. Refer to Division 26 “Wiring Devices” specification for additional requirements for floor boxes.
    d. Raceway routing shall be indicated for all in-slab conduits, cable trays and overhead conduits 2-inches and larger, based on final coordination with all other trades. Shop drawings shall clearly indicate areas with cable tray clearance limitations and/or other cable access limitations for review and approval by Owner, Architect, and Engineer.

6. Enlarged Plans:

    a. Provide 1/4” = 1’-0” enlarged plans of all communication rooms (as applicable) indicating the position of equipment cabinets and/or racks, wiring terminals, patch panels, grounding equipment, cable tray, fiber and copper terminations, and other low voltage systems equipment layout within the rooms.
    b. Shop drawings shall clearly indicate final conduit/riser (core drill and/or block-out) locations and sizes as coordinated and/or confirmed with Structural Engineer and any field conditions that impact proposed location.
    c. Shop drawings shall clearly indicate areas where equipment clearances may be limited, for review and approval by Owner, Architect, and Engineer.

7. Details: Document method of attachment of racks to the floor and ladder tray systems, method of attachment of wall mounted distribution frames, grounding details indicating grounding method for cabinets, racks, cable tray, cable management, and power details for rack mounted power distribution.

8. Elevations:

    a. Rack elevations (produced in Visio, ACAD, or similar) indicating exact placement of patch panels, fiber terminals and enclosures, vertical and horizontal cable managers, rack mounted power strips or distribution units, empty rack-units, etc.
    b. Wall elevations shall detail any and all known components to be mounted on the walls, whether those items are provided by Contractor producing shop drawings or not. Components shall include, but not be limited to, electrical and/or fire alarm panels, security panels, distributed antenna system (DAS), CATV, communication infrastructure distribution frames with block size, cable routing, cable management, pair counts, method of attachment, etc.

9. Drawing Scale: Shop drawings shall be drawn to scale and completely dimensioned as to clearly show construction detail.
10. Labeling: Provide documentation of all labeling schemes for conduit, back-boxes, cables, outlets, wiring blocks and/or patch panels, device faceplates, etc.
11. Documentation: Provide submittals and documentation as required by the project manual (in addition to electronic copies) for review or as indicated in Division 1 general conditions.

E. Record As-Built Drawings:

1. All record as-built drawings shall be provided on contractor specific title block. Contractor may use Technology Drawing files and/or shop drawings as a “starting point” for as-built drawings. As-built drawings shall comply with shop drawing requirements above but shall be updated to align with actual installation. Additionally, area plan drawings shall indicate all device labeling including, but not limited to, data port labels.
2. As-built files shall be a part of the final punch list and final deliverable. The project is not regarded as complete until JIS does a final walk thru, receives the final test results and as -built files.

1.4 QUALITY ASSURANCE

A. Codes and Standards: All materials and installations shall comply with current version of applicable codes and standards, including but not limited to:

1. TIA-526: Standard Test Procedures for Fiber Optic Systems.
2. TIA-568-C.0: Generic Communications Cabling for Customer Premises.
3. TIA-568-C.1: Commercial Building Communications Cabling Standards, Part 1: General Requirements.
4. TIA-568-C.2: Balanced Twisted-Pair Communications Cabling and Components Standard.
5. TIA-568-C.3: Optical Fiber Cabling Components Standard.
6. TIA-569: Commercial Building Standard for Telecommunications Pathways and Spaces.
7. TIA/EIA-604: Fiber Optic Connector Intermate2705ability Standards (FOCIS).
8. TIA-606: Administrative Standard for Commercial Telecommunications.
9. ANSI/J-STD-607-A: Commercial Building Grounding and Bonding Requirements for Communications.
10. TIA-758-A: Customer-Owned Outside Plant Communications Cabling Standard.
11. TIA-942: Telecommunications Infrastructure Standard for Data Centers.
12. ASTM: American Society for Testing and Materials
13. BICSI CO-OSP Design Manual (current edition): Customer-Owned Outside-Plant Design Manual.
14. BICSI Electronic Safety and Security (ESS) Design Reference Manual (current edition).

15. BICSI Network Design Reference Manual (current edition).
16. BICSI TDM Telecommunications Distribution Methods Manual (current edition).
17. BICSI Wireless Design Reference Manual (current).
18. TIA TSB67: Transmission Performance Specifications for Field Testing of Unshielded Twisted-Pair Cabling.
19. ICEA: Insulated Cable Engineers Association
20. IEEE-802.11 a, b, g, n: Wireless Local Area Networks
21. IEEE-802.3: 10Mb/s, 100Mb/s, 1Gb/s, and 10Gb/s Ethernet Standards as applicable based on media types (twisted pair copper, fiber optics, etc.)
22. IEEE-802.3ak: 10Gb/s Ethernet (evolving copper standard).
23. IEEE-802.3af: Power-over-Ethernet (PoE).
24. IEEE-1100-1999: Recommended Practice for Powering and Grounding Sensitive Electronic Equipment.
25. IEEE-241: Recommended Practice for Electric Power Systems in Commercial Buildings.
26. ISO/IEC 11801: International Standard on Information Technology – Generic Cabling of Customer Premises.
27. NESC: National Electrical Safety Code
28. NEMA Stds Pub No. VE 1, Cable Tray Systems. Additionally, comply with current edition of NEC, as applicable to construction and installation of cable tray systems.
29. NEMA Std 250: Enclosures for Electrical Equipment (1000 Volts Maximum).
30. NFPA-70/NEC: National Electrical Code.
31. NFPA-72: National Fire Alarm and Signaling Code
32. UL Compliance: Provide products which are UL-listed and labeled.
33. USDA Bulletin 1751F-643: Underground Plant Design.
34. Maryland Court of Appeals Judiciary Information Systems (JIS) and Department of General Services (DGS) Standards as Applicable

B. Manufacturer and Product Qualifications

1. Provide products from manufacturers regularly engaged in the production of communications infrastructure components, including but not limited to, raceway, horizontal copper cabling, copper and fiber optic backbone cabling, and connecting hardware.
2. Provide products from manufacturers whose products of similar types, capacities, and characteristics have been in satisfactory use in similar type projects for not less than five years.

C. Contractor Qualifications:

1. Firms with at least seven (7) years of successful installation experience with projects utilizing communications structured cabling, media systems, infrastructure, raceway and equipment similar to that required for this project.
2. The company shall have a fully staffed office with technical installations support personnel within 30 miles of the project. (Exceptions to this shall be confirmed through approval by the Owner, Architect, Contractor, and Engineer.)
3. The Low Voltage Raceway Contractor shall be a certified installer (current and in good standing with proven history) of the selected manufacturer’s raceway systems and shall provide a 25-year warranty on installation and applications.
4. The Low Voltage Cabling Contractor shall be a certified installer (current and in good standing with proven history) of the selected manufacturer’s structured cabling systems, and shall provide a 25-year warranty on structured cabling installation and applications.
5. The company shall have a BICSI RCDD on staff.

D. All materials shall be Underwriters Laboratories (UL) or Intertek Testing Services (ETL) Listed unless otherwise indicated.

E. Coordinate with local communications service provider(s) for primary and diverse service to Telecommunications Demarcation location(s) within the facility.

F. Coordinate with electrical work and other trades to properly interface installation of telephone system with other work.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver equipment and components in factory-fabricated containers or wrappings, which properly protect equipment from damage.

B. Store equipment and components in original packaging. Store inside in a well-ventilated space protected from weather, moisture, soiling, humidity, and extreme temperatures.

C. Handle equipment and components carefully to prevent damage. Do not install damaged units or components; replace with new.

1.6 SEQUENCING AND SCHEDULING

A. All work shall be reviewed and coordinated with the Construction Manager and/or General Contractor prior to commencing.

B. Communication systems, infrastructure, raceway and equipment are sensitive to environmental conditions including but not limited to temperature, dirt, dust, and water. The contractor shall ensure the storage and installation of all communication components are sequenced and scheduled accordingly to prevent any damage, loss of performance, and warranty void of such systems. All mis-installed components shall be replaced with new parts and re-installed at the Contractor’s expense.

C. Coordinate installation with Structural, Electrical, HVAC, Plumbing, Fire Protection, and other trades to eliminate disruption and/or conflict with other systems.

D. Coordinate underground installation with Civil, Structural, Electrical, and other trades to eliminate disruption and/or conflict with other systems (paving, curb and gutter, etc.).

E. Sequence installation of communications systems and infrastructure with other work to minimize possibility of damage and soiling during remainder of construction.

1.7 PROJECT SITE CONDITIONS

A. Prior to submitting a proposal, the Contractor shall inspect the Contract Documents, and shall become fully informed as to laws, ordinances, and regulations affecting the project. The Contractor shall immediately bring to the Owner, Architect, and Engineer’s attention, in writing, any existing condition or statute that contradicts, is in conflict with, or negates the Contract Documents. Failure of the Contractor to become fully informed as to all above mentioned items shall in no way relieve the Contractor from any obligations with respect to their proposal.

B. The Technology Drawings depict equipment locations, backboxes, conduit runs, cabling, etc. in a schematic manner. Field conditions and coordination with related trades may warrant relocations of field devices. No additional compensation will be allowed due to these revisions.

1.8 WARRANTY

A. The manufacturer shall provide a warranty with a minimum term of 25-years for structured cabling and all communications cable infrastructure components. This warranty shall cover all components including cables, jacks, patch panels, and wiring panels, etc. to maintain the specified performance, physical criteria, and applications assurance. Any such components, link, or channel shall be replaced by the Manufacturer at no cost to Owner during this period. The Contractor and Manufacturer shall submit all information and documentation on Warranty.

B. A one (1) year warranty on the Work shall be provided by the Contractor. If, within one (1) year after the date of final acceptance of the installation or within such longer period of time as may be prescribed by law or by the terms of any applicable special warranty required by the Contract Documents or provided by a manufacturer, any of the work or equipment is found to be defective or not in accordance with the Contract Documents, the Contractor shall correct it promptly including all parts and labor after receipt of notice from the Owner to do so unless the Owner has previously given the Contractor a written acceptance of such condition. This obligation shall survive termination of the contract. The Owner shall give such notice promptly after discovery of the condition. Such notice shall be provided by Owner representatives, to be identified, either verbally or in writing.

C. Nothing contained in the Contract Documents shall be construed to establish a shorter period of limitation with respect to any other obligation which the Contractor might have under the Contract Documents or any manufacturer's warranty. The establishment of the time period noted above, after the date of final acceptance or such longer period of time as may be prescribed by law or by the terms of any warranty required by the Contract Documents, relates only to the specific obligation of the Contractor to correct the work or equipment, and has no relationship to the time within which his obligation to comply with the Contract Documents may be sought to be enforced, nor to the time within which proceedings may be commenced to establish the Contractor's liability with respect to his obligations other than specifically to correct the work or equipment.

D. If system operation is not fully restored during the warranty period within two (2) business days, the Owner reserves the right to require the Contractor to provide on-site manufacturer's service technicians at no additional cost.

E. The Owner reserves the right to expand or add to the system during the warranty period using firm(s) other than the Contractor for such expansion without affecting the Contractor's responsibilities, provided that the expansion is done by a firm which is an authorized dealer or agent for the equipment of system being expanded.

1.9 SPECIFICATION RESPONSE

A. Pricing

1. Instructions to Bidders

a. The following is a partial list of instructions. Bidders are responsible to provide a complete proposal inclusive of all information requested in the Contract Documents.
b. Do not assume anything. Clarify your position in writing with your bid concerning any areas that may not be clear to you.
c. Copies of the bid proposal shall be submitted to the Owner, Architect, and Engineer for review and approval.

d. Bidders shall prepare equipment lists showing each item included in the bid. Equipment Lists must include the quantity, model number, manufacturer and price of each item listed under the generic description.
e. Provide a detailed description of any and all voluntary alternates and include cost changes in the Voluntary Alternate Bid forms. Bidders should submit voluntary alternates that will either provide for a better system or reduce costs without degrading the system. This includes alternate manufacturer and product substitution.
f. In the instance where the Drawings and the Specifications do not directly coincide, or coincide individually, the item of better quality, greater quantity and/or higher cost shall be included in the base bid.

2. Unit Pricing and Labor Rates

a. Unit prices and labor rates submitted with the bid proposal shall be used for all additions, deductions, and alterations of the original contract up to the date of submittal review of product data and shop drawings.

B. Compliance

1. Bidders shall submit a Statement of Qualifications with their bid proposal that shall include the following information:

a. Company name, address, telephone number and contact person.
b. Brief company history.
c. Resumes of key personnel.
d. Local staffing description (job descriptions and numbers of persons in each position).
e. Local service capabilities (hours of operation and parts availability).
f. Technician factory certifications.
g. Description of local engineering and project management capabilities.
h. Line sheet listing major suppliers of security equipment.
i. Annual dollar value of sales, installation and service of each product line carried.
j. List of references describing three (3) completed projects of similar size and complexity, including names and telephone numbers of the contact persons.
k. List of references describing similar projects completed in the area including names and telephone number of the customer's contact person.
l. List of similar projects currently under construction in the area including names and telephone numbers of the customer's contact person.
m. Licensing information.

2. Provide a specification COMPLIANCE MATRIX indicating compliance or deviation for each item in the specification. The matrix shall be comprised of a list of all numbered paragraphs that appear in this Specification. This matrix is critical for submittal review. See example Compliance Matrix template in Appendix 2.
3. Additionally, as described in this Specification, bidders shall submit the following information with their bid proposal:

a. Manufacturer's literature sheets for all standard manufactured items included in the equipment list and as proposed in the Voluntary Alternate Bid form, if applicable.
b. Workload and capability statements. The statements shall detail projects that will be active during the completion of this project, and the manpower that would be available for this project.

c. Confidentiality and return statements. The statements shall guarantee that the Contract Documents shall not be copied or distributed physically or verbally. The Contractor shall also assure the Owner that the Contract Documents shall be returned in their entirety upon request. The successful Contractor will be provided with as many copies as requested.
d. Copy of manufacturer's certification certificate.

4. Certain paragraphs of the Specification require the Bidder to provide information (possibly not listed above) in the proposal to demonstrate compliance with a requirement. If the Bidder fails to provide detailed responses to these items, the proposal will be deemed to be non-compliant to the paragraphs stated.
5. Number all pages of the bid submittal.

1.10 DEFINITIONS

A. Acronyms and Definitions

1. Refer to Technology Symbol Legend and Abbreviations shown on drawings.

PART 2 - SPECIFICATIONS

2.1 GENERAL REQUIREMENTS

A. Refer to each of the specification sections listed below for requirements:

1. 27 05 26: Telecommunications Grounding and Bonding
2. 27 05 33: Telecommunications Raceway and Boxes
3. 27 05 36: Cable Trays
4. 27 11 00: Communications Equipment Room Fit-out
5. 27 13 13: Communications Copper Backbone Cabling
6. 27 13 23: Communications Optical Fiber Backbone Cabling
7. 27 15 00: Communications Horizontal Cabling
8. 27 41 00: Audio Visual Systems
9. 27 53 20: Distributed Antenna System (DAS)

PART 3 - EXECUTION

3.1 INSTALLATION REQUIREMENTS

A. General:

1. The Contractor shall comply with all project expectations and submittal requirements as indicated in Part 1 of this specification. This includes initiating a "CA kickoff" meeting to discuss general project expectations with the project team.
2. Examine areas and conditions under which communications systems and infrastructure are to be installed. Notify Owner, Architect, and Engineer in writing of conditions detrimental to proper completion of the work. Do not proceed with work until unsatisfactory conditions have been corrected in a manner acceptable to installer.
3. The Contractor shall be knowledgeable of work to be performed by other trades and take necessary steps to integrate and coordinate their work with other trades.

4. The Contractor is required to coordinate their efforts with the other trades and sub-contractor who may be working within the same vicinity to avoid conflict and lost time.
5. The Contractor shall be responsible for furnishing all materials indicated on the drawings or as specified herein for a complete communications system.
6. The Contractor shall supply all necessary tools, equipment, accessories, safety equipment, protective clothing, etc., as customary for the craft and necessary for the installation.
7. All communications infrastructure shall be installed in an aesthetically pleasing fashion. All surface raceway in new buildings must be approved by the Owner, Architect, and/or Engineer.
8. All communications infrastructure shall be installed for optimal performance.
9. All communications infrastructure shall be installed to allow for convenient operation, testing, and easy adds, moves, and other changes in the future.
10. All components noted in Technology drawings and specifications shall be provided and completely setup and installed.
11. The Contractor shall verify space requirements and locations before starting cable installations and terminations. Inappropriate conditions shall be immediately reported to Construction Manager or General Contractor, Owner, Architect, and Engineer prior to initiating installation.
12. The contractor shall not install any component in a manner or condition that will void manufacturer and/or contractor warranty. Any such conditions that prevent an acceptable install shall be immediately reported to Construction Manager or General Contractor, Owner, Architect, and Engineer prior to initiating installation. All mis-installed components will be removed and replaced with new at the Contractors expense. No additional cost will be submitted to Owner.

B. Communications Room Fit-out:

1. Construction within communication rooms must be substantially complete before the installation of telecommunications cabling. This includes, but is not limited to, the installation of plywood backboard, cable tray or ladder rack, electrical outlets, light fixtures, sprinklers and ductwork. All walls shall also be painted before the installation of telecommunications cabling.
2. Communications rooms must be free from dust, dirt, and other foreign materials before the installation of any termination hardware or the termination of copper or fiber optic cables. The door to the telecommunication rooms must be installed and closed during termination.
3. Floor to floor distribution shall be provided with concrete floor sleeves or conduits as noted on the drawings, and as required by the architectural design.

C. Communications Raceway Infrastructure:

1. Contractor shall provide conduits through walls and across inaccessible ceiling spaces to ensure unobstructed pathway back to the nearest communications room or cable tray.
2. Provide protective cable bushings on all conduits immediately after installation.
3. Telecommunications conduits shall maintain large radius bends and sweeps. Use electrical 45º or 90º conduit elbows with long bend radii. Provided below are the ratios for minimum conduit bend radius to conduit size diameter:

    a. 6:1 bend radius of the inside conduit diameter for conduit sizes less than 2-inches.
    b. 10:1 bend radius of the inside conduit diameter for conduit sizes equal to or greater than 2-inches.

4. Telecommunications raceways shall have a maximum pulling length of 100 feet and a maximum 180º total sum of all elbows, sweeps and bends for each pulling length. The maximum bend for any location shall not exceed 90º and a maximum of two 90º bends or equivalent shall be allowed. Pull-boxes or junction-boxes shall be provided where necessary to comply with these requirements.
5. Pull boxes shall be provided in straight sections of conduit only. Pull boxes shall not be used to change pathway direction in any locations.
6. Conduit outlet bodies (i.e., condulet, C, LB, LL, LR, T), shall not be used as cable pull points or to change pathway direction in any locations. These devices are commonly used for electrical/power pathways and are not approved for low voltage cabling.
7. Provide expansion capability in conduit or raceway crossing building expansion joints. Reference architectural and structural drawings for expansion joint locations.
8. Fire-seal all raceway penetrations and openings to maintain fire rating after communications cables are installed.
9. All empty raceway systems shall have pull line or tape installed with three feet extending from each end, knotted and secured to remain in place.
10. Cable fill in riser conduits shall not exceed 40% cable fill.
11. Where applicable, the Contractor shall verify existing cable fill in riser conduit before installation of additional cables so as not to exceed 40% cable fill. Contractor is responsible for installation of additional riser conduit, where additional cables to be added will exceed the 40% cable fill.

D. Communications Cabling Infrastructure:

1. Contractor shall not paint cables and/or spray cables with fire proofing material as it can affect cable performance and will void the cable warranty.
2. All communications cable routed within communications rooms shall be bundled and combed to provide a neat and organized appearance. Cables shall be bundled using only manufacturer and industry approved Velcro wire ties (zip ties shall not be used) with tensions that do not deform and damage cable resulting in loss of transmission or performance. Any bundles and combing methods used shall not exceed manufacturer or industry standards recommendations for that cable type.
3. Contractor shall provide dedicated J-hooks at 48-inches on-center for all communications cabling not run within conduit or cable tray.
4. The contractor shall not install any cable in conduits that do not have the appropriate protect bushings on conduit ends. All mis-installed cable will be removed, bushings installed, and new cable re-installed at the Contractors expense. No additional cost will be submitted to Owner.
5. Cable bends shall not be greater than that recommended by the manufacturer of the cable.
6. Care shall be taken so as not to damage cable during the installation process and that manufacturer’s pull tension specification is not exceeded.
7. Provide a minimum 8’-0” and maximum 10’-0” of slack. Loop at the IC-rooms to be contained on the horizontal cable tray or ladder rack.
8. Provide a minimum of 3’-0” of slack for all device cable termination points. Slack shall be contained in accessible ceiling near the final termination point or in the cable tray nearby when continuous conduit is routed back to cable tray.
9. Communications cabling that is bundled within cable trays and supported from j-hooks shall be snugly wrapped using Velcro reusable cable ties as minimum of every 3’-0” for cable organization. Velcro ties shall be tightened so as not to deform cable jackets and thus affect cable performance. Plastic cable tie wraps shall not be used anywhere on the project.
10. Cables from different low voltage systems (ex. 70v Speaker, BMS, etc.) shall not be run in the same conduit pathways with horizontal or backbone UPT cabling, unless specifically noted on the drawings.

11. Any other Low Voltage scopes including but not limited to BMS, Fire Alarm, AV and Broadcast cabling that are run in common communications infrastructure shall comply with the installation requirements in the Division 27 specifications. The Contractor shall ensure that all scopes that use the installed infrastructure comply with these guidelines or provide dedicated pathways for those systems.

E. Electrical Clearances: Where telecommunications cabling is not fully enclosed in metallic conduit or solid metallic raceway, it shall be routed to maintain appropriate clearances from potential interfering electrical sources per NEC, TIA, and BICSI requirements. Provided below are minimum clearance requirements of key components that shall be maintained.

1. 120V Power Conduits: 6-inches (150mm)
2. 208V and Higher Power: 12-inches (300mm)
3. Lighting System: 12-inches (300mm)
4. Transformers: 48-inches (1200mm)
5. Motors and Fans: 48-inches (1200mm)
6. Other Interfering Sources to be field verified and coordinated by Contractor with Architect and Engineer.

3.2 LABELING

A. All communications components shall be clearly labeled using labeling devices (i.e., handwritten labels are not acceptable) with white label and black text. All labels shall be consistent font type and size (for respective components).

B. The following indicates the recommended labeling scheme for various components. The final labeling scheme shall be coordinated with the Owner, Architect, and Engineer prior to finalizing and initiating any work. A sample scheme shall be submitted for approval.

1. Backbone Cables (to TRs):

a. Label provided at both ends shall indicate origin room such as MTR (Main Telecom Room), the TR room designator (where cable is routed to) and a cable number if multiple cables are provided to a single TR location.

1) Example: “MTR-3A” = single cable from MTR to TR on level 3, riser A.
2) Example: “MTR-3A-2” = cable 2 of multiple cables from MTR to TR on level 3, riser A.

b. Where redundant backbone cables originate from a location other than the “MTR”, such as a Data Center or another TR, the redundant cables shall use the designator “DC” or the applicable TR designator.

1) Example: “DC-3A” = single cable from DC to TR on level 3, riser A.
2) Example: “3A-3D” = single cable between TR-3A and TR-3D.

2. Backbone Cables (to Remote Hubs):

a. Label provided at both ends shall indicate point of origin (i.e., MTR or TR designator), enclosure designator (where cable is routed to) and a cable number if multiple cables are provided to a single TR location.

b. Enclosure boxes shall be indicated by an “E” followed by a number for the enclosure.

1) Example: “MTR-E1” = single cable from TR to enclosure box “1”.
2) Example: “3A-E4” = single cable from TR-3A to enclosure box “4”.

c. AV Rooms (or other miscellaneous rooms) with Communications backbone cable terminations shall have a special indicator such as “SCR” (Scoreboard Control Room), “AR#” (Amplifier Room #), etc.

1) Example: “MTR-SCR” = single cable from MTR to Scoreboard Control Room.
2) Example: “3A-AR2” = single cable from TR-3A to Amplifier Room #2”.

3. Horizontal Cables:

a. Label provided at both ends shall indicate point of origin (i.e., MTR or TR designator), patch panel designator (A, B, C, etc.), and port number (01, 02, 03, etc.).

1) Example: “MTR-A.23” = horizontal cable originating from port “23” on patch panel “A” at the MTR.
2) Example: “3A-C.23” = horizontal cable originating from port “23” on patch panel “C” at TR-3A.

4. Device Faceplates:

a. Label provided at each faceplate shall indicate point of origin (i.e., MTR or TR designator) for cables terminated at that device.

1) Example: “MTR” = Device faceplate for cables originating from the MTR.
2) Example: “3A” = Device faceplate for cables originating from TR-3A.

5. Device Outlets:

a. Label provided at each device jack/outlet shall indicate patch panel designator (A, B, C, etc.) and port number (01, 02, 03, etc.) for cable point of origin.

1) Example: “A.23” = horizontal cable originating from port “23” on patch panel “A” at the room indicated on the faceplate label.

6. Patch Panels (Horizontal and Backbone Cable Terminations):

a. Labels provided at patch panels for HORIZONTAL cable terminations shall start with “A” for the first patch panel (in each room) and letter sequentially (B, C, etc.) thereafter.
b. Labels provided at patch panels for BACKBONE cable terminations shall start with “AA” for the first patch panel (in each room) and letter sequentially (BB, CC, etc.) thereafter.
c. Patch panel ports shall be labeled for each panel starting with “1” or “01” and numbering each port sequentially.

7. Fiber Termination Panels

    a. Label provided at termination panels for backbone or horizontal fiber optic cabling shall start with “1” for the first panel (in each room) and number sequentially (2, 3, etc.) thereafter.
    b. Fiber termination panel ports shall be labeled for each panel starting with “1” or “01” and numbering each port sequentially.

8. Wiring Blocks (Copper Backbone Terminations, if applicable)

    a. Label provided at termination panels for copper backbone cabling shall start with “1” for the first block (in each room) and number sequentially (2, 3, etc.) thereafter.

9. Cabinets / Racks

    a. Label provided at cabinets shall start with “CABINET-1” for the first cabinet (in each room) and number sequentially (CABINET-2, etc.) thereafter.
    b. Label provided at racks shall start with “RACK-1” for the first rack (in each room) and number sequentially (RACK-2, etc.) thereafter.

10. Grounding Busbars

    a. Labels are not required for the grounding busbars.

11. Grounding Conductors

    a. Label provided at the TMGB end of the Telecommunications Bonding Backbone (TBB) shall indicate the Communications Room where the cable originates from.

        1) Example: “5A” = TBB originating from TR-5A, routed down through Riser-A Communications Rooms and terminated on the TMGB.

    b. Label provided at each end of a Grounding Equalizer (GE) cable interconnecting two I-TGBs shall indicate both Communications room designators.

        1) Example: “3A-3D” = GE routed between I-TGBs in TR-3A and TR-3D.

    c. Label provided at each end of grounding cable routed from a ground busbar to the nearest Electrical Ground Busbar shall indicate the Communications room designator and “EGB” for nearest “Electrical Grounding Busbar.”

        1) Example: “3A-EGB” = Grounding conductor routed between TGB in TR-3A and the EGB in the nearest Electrical Room.

    d. Label provided at each end of the Equipment Bonding Conductors (EBC) interconnecting each rack, cabinet, ladder rack, etc. within a Communications Room back to the TGB or TMGB shall start with “1” for the first cable (in each room) and number sequentially (2, 3, etc.) thereafter.

12. Conduits

    a. Label provided each end of Low Voltage conduits shall indicate the point of origin for the opposite end, such as the Communications Room designator or device location Room Number.

b. Final room number labeling shall be coordinated with the Owner, Architect, and Engineer prior to initiating work.
c. Horizontal device conduit originating from a nearby cable tray (if applicable) shall indicate “TRAY” at the device end and the device location (i.e., room number) at the cable tray end.
d. Horizontal device conduit originating from accessible ceiling directly above a device does not require labels at either end.
e. Conduit sleeves (10-ft or shorter) do not require labels at either end.

13. Pull-boxes

a. Label provided pull-boxes or conduit ends terminating into a pull-box shall clearly indicate where each conduit originates from, based on “conduit” section above.

END OF SECTION

APPENDIX 1 - EQUIPMENT SCHEDULE

NOTE: There is no product number appendix for this section. Refer to other Division 27 specification sections for specific product information.

APPENDIX 2 - SPECIFICATION COMPLIANCE MATRIX TEMPLATE

Indicate compliance of the proposed equipment and/or services by the word "Comply" following each paragraph number. Indicate an exception to the requirement by the word "Exception" following the applicable paragraph number. Should the proposed equipment and/or services not entirely comply with the requirements specified, but ultimately achieve the intent, the Bidder shall explain fully the extent, or lack thereof, of compliance for the applicable equipment and/or services proposed. Instances where there is no indication of compliance or exception shall be considered non-compliant.

Contractor shall submit Compliance Matrix with the Bid Proposal AND at the time of Product Data submittal (as indicated previously in this specification) so that a complete system submittal reviewed can be performed. Contractor shall use the following template to create a full Compliance Matrix for each specification section including Parts 1, 2 and 3.

	COMPLIANCE	**EXPLANATION**
PART 1		
1.1		
A	COMPLY	
B	EXCEPTION	Note clarifications and/or reason for exception here.
C	COMPLY	
1.2		
A.1	COMPLY	
A.2	COMPLY	
B	COMPLY	
C.1	COMPLY	
C.2	COMPLY	
D.1a	COMPLY	
D.1b	COMPLY	
D.2a	COMPLY	
xx	COMPLY	
xx	COMPLY	

APPENDIX 3 - PRODUCT DATA & SHOP DRAWING SUBMISSION CHECKLIST

NOTE: Contractor shall utilize checklist below to ensure comprehensive product data and shop drawings are submitted for review, including submittals compiled between multiple sub-contractors (as applicable). This checklist is intended help establish submittal expectations specific to each specification section and to serve as a pre-check document for each contractor. Refer to submittal section of these specifications for additional requirements.

	GENERAL ITEMS
	Compliance matrix – Required for each Division 27 section
	Proposed project schedule (procurement, installation, final testing/punch, etc.)
	PRODUCT DATA
	Manufacturer warranty information
	Equipment component list – matching order of Appendix 1 for each Division 27 section
	Equipment specification sheets – matching order of Appendix 1 and with each part number highlighted to match the equipment component list
	Refer to 27 05 00 section 1.3-C for additional requirements

	SHOP DRAWINGS
	27 05 00 - Common Work Results for Communications (General requirements, applicable to all specification sections)
	All shop drawings, product data and compliance matrix to be submitted together
	Combined legends, plans, details, etc. may be provided to encompass multiple specification sections
	Refer to 27 05 00 section 1.3-D for additional requirements

	27 05 26 - Telecommunications Grounding and Bonding
	27 05 26 and 27 11 00 to be submitted together if provided by same contractor
	Legend: indicate symbol key, labeling scheme, scope clarification notes, etc.
	One-lines: indicate all conductor types/rating, routing, connection points, labeling, etc.
	Details: indicate busbar components, connection types/points, etc.

	27 05 33 - Telecommunications Raceways and Boxes
	27 05 33 and 27 05 36 to be submitted together
	Legend: indicate symbol key, labeling scheme, scope clarification notes, etc.
	One-lines: indicate riser conduits / tray, conduit allocation per system (including spares), etc.
	Site plan: indicate other utilities, conduit types, entry points, etc.
	Floor plans: indicate rated walls/floors, tray/conduit routes, floor boxes, pull-boxes, plenum boxes, etc.
	Details: indicate conduit support systems, grounding, fire-proofing methods, etc.

	27 05 36 - Cable Trays (submit cable tray specific shop drawings with RCPs shown)
	27 05 33 and 27 05 36 to be submitted together
	Legend: indicate symbol key (including mounting height tags), scope clarification notes, etc.
	RCPs: indicate ceiling types, rated walls/floors, tray/conduit routes, access/clearances, etc.
	Details: indicate tray support systems, grounding, fire-proofing methods, etc.

	27 11 00 - Communications Equipment Room Fit-Out
	27 05 26 and 27 11 00 to be submitted together if provided by same contractor
	Legend: indicate symbol key, labeling scheme, scope clarification notes, etc.
	Floor plans: indicate rack positions, ladder rack, conduit allocation and stub-up locations, etc.
	Wall elevations: indicate wall mounted cable tray, conduit stub-ups, wall mounted SCPs, DAS, etc.
	Rack elevations: indicate fiber termination shelves, patch panels, cable managers, AV equipment, Owner equipment, PDUs, UPS etc.
	Details: indicate rack and cable tray mounting details, conduit supports, rack-to-floor attachments, etc.

	27 13 13 - Communications Copper Backbone Cabling
	Legend: indicate symbol key, labeling scheme, scope clarification notes, etc.
	One-lines: indicate all cable types/rating, routing, termination types, labeling, etc.
	Rack elevations: submit with 27 11 00

	27 13 23 - Communications Optical Fiber Backbone Cabling
	Legend: indicate symbol key, labeling scheme, scope clarification notes, etc.
	One-lines: indicate all cable types/rating, routing, termination types, labeling, etc.
	Rack elevations: submit with 27 11 00
	Details: indicate termination plate details and placement in remote enclosures, AV racks, etc.

	27 15 00 - Communications Horizontal Cabling
	Legend: indicate symbol key, labeling scheme, scope clarification notes, etc.
	Site plan: indicate OSP cable routes, termination locations, etc.
	Floor plans: indicate updated comm room divider lines, device labels, typical conduit paths, etc.
	Rack elevations: submit with 27 11 00
	Details: indicate termination plate details and placement in remote enclosures, AV racks, etc.

SECTION 27 05 26 - TELECOMMUNICATIONS GROUNDING AND BONDING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Product Appendix: Refer to Appendix 1, Equipment Schedules, at the end of this section, for specific product information on the benchmark products. These equipment schedules should be the baseline for product data submittals but are not intended to be an all-encompassing bill of materials, unless noted otherwise.

B. Refer to Section 27 05 00 (Part 1 and Part 3) for requirements that shall be fulfilled as part of this specification section.

C. General provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections.

D. Architectural, Electrical, and Technology Drawings. Other systems drawings may apply.

E. Division 26 Specifications. Coordinate Electrical System requirements. Basic Electrical Materials and Methods sections apply to work of this section.

F. Rough carpentry is specified in a Division 6 section.

1.2 SUMMARY

A. Refer to Section 27 05 00 for requirements that shall be fulfilled as part of this specification section.

B. Extent of telecommunications grounding and bonding work is indicated by Technology Drawings (one-line, enlarged plans, and details) and as specified herein. Grounding and bonding work is defined to encompass systems, circuits, and equipment.

C. A dedicated telecommunications ground system shall be provided with insulated bonding backbones (TBB) as applicable, equalizing conductors (TEC) as applicable, and pre-drilled copper busses (TMGB and TGB) shall be provided at each communications room to bond metallic equipment and hardware components.

D. Applications of telecommunications grounding and bonding work in this section includes, but may not be limited to: raceways such as conduits and cable trays, metallic cable sheaths, equipment enclosures, cabinets and racks, building structure, electrical power and/or grounding systems components, service equipment, etc.

E. Refer to other Division 26 and Division 27 sections for wires/cables, telecommunications raceways, boxes and fittings, and wiring devices which are required in conjunction with telecommunications grounding and bonding work; not work of this section.

1.3 SUBMITTALS

A. General Description and Requirements

1. Refer to Section 27 05 00 for requirements that shall be fulfilled as part of this specification section.

B. Product Data:

1. Refer to Section 27 05 00 for requirements that shall be fulfilled as part of this specification section.

C. Prefabrication Shop Drawings:

1. One-Line Wiring Diagrams: Include one-line wiring diagrams for telecommunications grounding and bonding work which indicate routing of grounding electrode conductors, equipment grounding connections and busbars.
2. Details: Indicating grounding method for cable tray and cabinets and/or racks.
3. Labeling: Provide documentation of all labeling schemes for grounding busbars and grounding conductors.
4. Documentation: Provide an electronic copy for review or as indicated in Division 1 general conditions.

1.4 QUALITY ASSURANCE

A. Refer to Section 27 05 00 for requirements that shall be fulfilled as part of this specification section.

B. Manufacturer’s Qualifications: Firms regularly engaged in manufacture of grounding and bonding products, of types, and ratings required, and ancillary grounding materials, including stranded cable, copper braid and bus, grounding electrodes and plate electrodes, and bonding jumpers whose products have been in satisfactory use in similar service for not less than 5 years.

C. Installer’s Qualifications: Firms with at least 5 years of successful installation experience on projects with telecommunications grounding work similar to that required for project.

D. Codes and Standards:

1. Electrical Code Compliance: Comply with applicable local electrical code requirements of the authority having jurisdiction, and the current edition of the NEC as applicable to electrical grounding and bonding, pertaining to systems, circuits and equipment.
2. UL Compliance: Comply with applicable requirements of UL Standards No.’s 467, Electrical Grounding and Bonding Equipment”, and 869 “Electrical Service Equipment”, pertaining to grounding and bonding of systems, circuits and equipment. In addition, comply with UL Std 486A, “Wire Connectors and soldering Lugs for Use with Copper Conductors.” Provide grounding and bonding products which are UL-listed and labeled for their intended usage.
3. IEEE Compliance: Comply with applicable requirements and recommended installation practices of IEEE Standards 80, 81, 141 and 142 pertaining to grounding and bonding of systems, circuits and equipment.
4. TIA Compliance: Comply with applicable requirements and recommended installation practices of the current editions of TIA Standards 568, 569, and 607.

5. BICSI Compliance: Comply with applicable requirements and recommended installation practices of the current editions of BICSI Standards TDM, CO-OSP, Data Network Design Reference Manual, and Wireless.

PART 2 - SYSTEM REQUIREMENTS

2.1 GENERAL

A. Materials and Components:

1. Provide telecommunications grounding and bonding system; with assembly of materials, including, but not limited to, cables/wires, connectors, solderless lug terminals, grounding electrodes and plate electrodes, bonding jumper braid, surge arresters, and additional accessories needed for a complete installation. Where more than one type of component product meets indicated requirements, selection is installer's option. Where materials or components are not indicated provide products which comply with NEC, UL, IEEE, NEMA, ANSI, TIA, and BICSI requirements and with established industry standards for those applications indicated.

2.2 BUS BARS

A. Materials and Components:

1. Provide telecommunications grounding bus bars with a TIA J-STD-607-A style and BICSI recommended bolt pattern.

B. Telecommunications Grounding Busbar (TMGB, TGB, I-TGB, and C-TGB):

1. Refer to Technology Drawings (grounding details) for additional requirements such as bonding conductor connections and dual busbar locations (such as TMGB) as applicable. Contractor shall provide multiple busbars if necessary, to accommodate the quantity of grounding cables that shall tie into the busbar, in particular the TMGB on larger projects.
2. Provide copper UL listed bus with pre-drilled two-hole bonding lugs.
3. Pre-drilled holes shall be primarily for 4 AWG two-hole bonding lugs. Holes shall be a nominal diameter of 5/16-inch (8mm) with 5/8-inch (16mm) between the hole's centerline.
4. Grounding busbar shall also have a minimum of (6) pre-drilled two-hole lug points for #3/0 AWG bonding lugs. Holes shall be a nominal diameter of 7/16-inch (11mm) with 1-inch (25mm) between the hole's centerline.
5. Grounding busbar shall have isolated stand-offs to provide a minimum 1-inch clearance off of wall.
6. Physical Size:

    a. TMGB: 20-inch x 4-inch x 1/4-inch.
    b. TGB and I-TGB: 10-inch x 2-inch x 1/4-inch.
    c. C-TGB (Cabinet): 19-inch x 1 inch x 1/4-inch.

2.3 CONDUCTORS

A. Insulated Conductors: Copper wire or cable insulated for 600V unless otherwise required by applicable Code or authorities having jurisdiction.

1. Telecommunications Bonding Backbone (TBB): Provide #3/0 AWG, unless noted otherwise.
2. Telecommunications Grounding Equalizers (GE): Provide #3/0 AWG, unless noted otherwise.
3. Tap Conductors: Provide #3/0 AWG unless noted otherwise.
4. Equipment and Component Bonding Conductors (EBC): Provide No. 4 or No. 6 AWG, insulated stranded conductors based on conductor distances.

2.4 CONNECTORS

A. Listed and labeled by a nationally recognized testing laboratory acceptable to authorities having jurisdiction for applications in which used, and for specific types, sizes, and combinations of conductors and other items connected.

B. Compression Fittings: All cable splices from bonding backbone to tap conductors and tie cables shall use irreversible compression fittings to join cable ends.

C. Bolted Connectors for Conductors and Pipes: Copper or copper alloy, bolted pressure-type, with at least two bolts.

1. Pipe Connectors: Clamp type, sized for pipe.

D. Welded Connectors: Exothermic-welding kits of types recommended by Cadweld (or approved equal) manufacturer for materials being joined and installation conditions.

PART 3 - EXECUTION

3.1 APPLICATIONS

A. Conductors: Stranded conductors shall be used for all telecommunication ground cables, unless otherwise indicated.

B. Telecommunications Main Grounding Bus (TMGB):

1. Refer to Technology drawings for exact location.
2. Install bus on insulated spacers 1-inch (25 mm) minimum, from wall and 12-inches (300 mm) above finished floor, unless otherwise indicated.
3. The TMGB shall be connected to the main electrical service intersystem bonding termination with an insulated #3/0 (120mm^2) stranded grounding conductor installed in continuous conduits.
4. The TMGB shall be connected to building steel if existing within room with an insulated #3/0 AWG (120mm^2) stranded grounding conductor.

C. Telecommunications Grounding Bus (TGB):

1. Install in all low voltage or communication rooms. Refer to Technology drawings for exact locations.

2. Install bus on insulated spacers 1-inch (25 mm), minimum, from wall and 12-inches (300 mm) above finished floor, unless otherwise indicated.
3. The TGB shall be connected to the TMGB bus via the TBB with an insulated #3/0 AWG (120mm^2) stranded grounding conductor installed in continuous conduits.
4. The TGB shall be connected to the nearest AC electrical service intersystem bonding termination with an insulated #3/0 AWG (120mm^2) stranded grounding conductor installed in continuous conduits.
5. The TGB shall be connected to building steel if existing within room with an insulated #3/0 AWG (120mm^2) stranded grounding conductor.

D. Interconnected Telecommunications Grounding Bus (I-TGB):

1. I-TGBs (TGBs) shall be interconnected (daisy-chained) with a Telecommunications Grounding Equalizer (GE) installed in continuous conduit on the highest level installation, bottom level installation, and every third level in between (as applicable) to complete the Telecommunication Grounding System, per industry standards.
2. Install bus on insulated spacers 1-inch (25 mm), minimum, from wall and 12-inches (300 mm) above finished floor, unless otherwise indicated.
3. The I-TGB shall be connected to the TMGB bus via the TBB with an insulated #3/0 AWG (120mm^2) stranded grounding conductor installed in continuous conduits.
4. The I-TGB shall be connected to the nearest AC electrical service intersystem bonding termination with an insulated #3/0 AWG (120mm^2) stranded grounding conductor installed in continuous conduits.
5. The I-TGB shall be connected to building steel (if existing within room) with an insulated #3/0 AWG (120mm^2) stranded grounding conductor.

E. Cabinet Telecommunications Grounding Bus (C-TGB):

1. Install in Telecommunications Cabinets/Racks. Refer to Technology drawings for exact locations.
2. The C-TGB shall be connected to the TMGB bus via the TBB with an insulated #3/0 AWG (120mm^2) stranded grounding conductor installed in continuous conduits.
3. The C-TGB shall be connected to the nearest AC electrical service intersystem bonding termination with an insulated #3/0 AWG (120mm^2) stranded grounding conductor installed in continuous conduits.
4. The C-TGB shall be connected to building steel if existing within room with an insulated #3/0 AWG (120mm^2) stranded grounding conductor.

F. Conductor Terminations and Connections:

1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
2. Connections to Structural Steel: Welded connectors.

3.2 EQUIPMENT AND COMPONENT GROUNDING

A. Install insulated equipment grounding conductors to all telecommunications equipment and components.

B. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70, NEMA, ANSI, TIA and BICSI:

1. Armored and metal-clad cable sheaths.
2. Equipment Cabinets and Racks.
3. Cable trays and ladder racks.

4. Conduits sections and conduit sleeves.
5. Equipment and Power Supply Enclosures.
6. Wall mounted cable terminals.
7. Other metallic components as necessary.

3.3 EXAMINATION

A. Examine areas and conditions under which telecommunications grounding and bonding connections are to be made and notify Engineer in writing of conditions detrimental to proper completion of work. Do not proceed with work until unsatisfactory conditions have been corrected.

3.4 INSTALLATION OF TELECOMMUNICATIONS GROUNDING AND BONDING SYSTEMS

A. General: Install telecommunications grounding and bonding systems in accordance with manufacturer's instructions and applicable portions of NEC, NECA's "Standard of Installation", and in accordance with recognized industry practices to ensure that products comply with requirements.

B. Labeling:

1. The final labeling scheme shall be coordinated with Owner, Architect, and Engineer prior to finalizing and initiating any work. A sample scheme shall be submitted for approval.
2. Refer to Specification Section 27 05 00 for additional requirements that shall be fulfilled as part of this specification section.

C. Coordinate with other electrical and telecommunications work as necessary to interface installation of telecommunications grounding and bonding system work with other work.

D. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

E. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance, except where routed through short lengths of conduit.

1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install so vibration is not transmitted to rigidly mounted equipment.
3. Use exothermic-welded connectors for outdoor locations, but if a disconnect-type connection is required, use a bolted clamp.

F. Install all connectors on clean metal contact surfaces, to ensure electrical conductivity and circuit integrity.

G. Tighten grounding and bonding connectors and terminals, including screws and bolts, in accordance with manufacturer's published torque tightening values for connectors and bolts. Where manufacturer's torquing requirements are not indicated, tighten connections to comply with tightening torque values specified in UL 486A to assure permanent and effective grounding.

H. Apply corrosion-resistant finish to field-connections, buried metallic grounding and bonding products, and places where factory applied protective coatings have been destroyed, which are subjected to corrosive action.

I. Install all connectors on clean metal contact surfaces, to ensure electrical conductivity and circuit integrity.

3.5 FIELD QUALITY CONTROL

A. Upon completion of installation of electrical grounding and bonding systems, test ground resistance with ground resistance tester. Where tests show resistance to ground is over 5 ohms, take appropriate action to reduce resistance to 5 ohms, or less, then retest to demonstrate compliance.

END OF SECTION

APPENDIX 1 - EQUIPMENT SCHEDULE

General Notes:
1. This specification is intended to be performance based, with the expectation that an “end-to-end” solution is provided by one of the “pre-approved” manufacturers (or partnerships) listed below.
2. Products listed below are intended to establish “benchmark” products from one or more of the “pre-approved manufacturers”. The listed benchmark products shall be used as a baseline when submitting products from a pre-approved manufacturer that does not have specific products listed.
3. Pre-approved manufacturers (listed in alphabetical order) include:
   a. Burndy
   b. Legrand / Ortronics
   c. Southwire

Table 1 - Telecom Grounding Components			
Item	**Part Name/Description**	**Manufacturer**	**Part Number**
1	Telecom Main Grounding Busbar - 4"W x 20"L		
		Legrand / Ortronics	GB4X20TMGB
2	Telecom Grounding Busbar - 2"W x 10"L		
		Legrand / Ortronics	GB2X10TGB
3	3/0 Grounding Conductor (Green)		
		Southwire	GN:556123
4	C-Type Compression Taps		
		Legrand / Ortronics	CTHD4666
5	#6 AWG Bonding Conductor (Green)		
		Southwire	GN:204974
6	Compression Lugs - #6 AWG		
		Legrand / Ortronics	CL2LB6A
7	Compression Lugs - 3/0 AWG		
		Burndy	YAZ272TC38
8	Telecom Horizontal Ground Bar Kit for Remote Cabinet		
		Legrand / Ortronics	GBH19KIT

APPENDIX 2 - SPECIFICATION COMPLIANCE MATRIX TEMPLATE

Indicate compliance of the proposed equipment and/or services by the word "Comply" following each paragraph number. Indicate an exception to the requirement by the word "Exception" following the applicable paragraph number. Should the proposed equipment and/or services not entirely comply with the requirements specified, but ultimately achieve the intent, the Bidder shall explain fully the extent, or lack thereof, of compliance for the applicable equipment and/or services proposed. Instances where there is no indication of compliance or exception shall be considered non-compliant.

Contractor shall submit Compliance Matrix with the Bid Proposal AND at the time of Product Data submittal (as indicated previously in this specification) so that a complete system submittal reviewed can be performed. Contractor shall use the following template to create a full Compliance Matrix for each specification section including Parts 1, 2, and 3.

	COMPLIANCE	**EXPLANATION**
PART 1		
1.1		
A	COMPLY	
B	EXCEPTION	Note clarifications and/or reason for exception here.
C	COMPLY	
1.2		
A.1	COMPLY	
A.2	COMPLY	
B	COMPLY	
C.1	COMPLY	
C.2	COMPLY	
D.1a	COMPLY	
D.1b	COMPLY	
D.2a	COMPLY	
xx	COMPLY	
xx	COMPLY	

This page is intentionally left blank.

SECTION 27 05 33 - TELECOMMUNICATIONS RACEWAYS AND BOXES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Product Appendix: Refer to Appendix 1, Equipment Schedules, at the end of this section, for specific product information on the benchmark products. These equipment schedules should be the baseline for product data submittals but are not intended to be an all-encompassing bill of materials. Submit other proposed raceway and box products described within this specification and shown on the Technology Drawings along with related Division 26 product submittals with a clear note that Division 27 review is required.

B. Refer to Section 27 05 00 (Part 1 and Part 3) for requirements that shall be fulfilled as part of this specification section.

C. General provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections.

D. Architectural, Electrical, and Technology Drawings. Other systems drawings may apply.

E. Division 26 Specifications. Coordinate Electrical System requirements. Basic Electrical Materials and Methods sections apply to work of this section, including, but not limited to, Raceway and Boxes section for conduit connectors, fittings, and couplings.

F. Division 27 Specifications. Provide requirements in all corresponding Division 27 Specifications.

G. Division 7 Specifications. Coordinate Section “Firestopping” for conduit penetrations through rated walls and slabs.

H. Vertical Transportation (Elevators, Escalators, etc.) Specifications and/or Codes Requirements.

I. Rough carpentry is specified in a Division 6 section.

1.2 SUMMARY

A. Drawings are diagrammatic. All bends, boxes, fittings, couplings are not necessarily shown. Supply as necessary to comply with the National Electric Code.

B. This Section includes raceways for low voltage cabling. Types of raceways, boxes and fittings in this section include the following:

1. Electrical metallic tubing (EMT).
2. Intermediate metal conduit (IMC).
3. Rigid metallic conduit (RMC).
4. Flexible metallic conduit – Not permitted without written approval.
5. Liquid-tight flexible conduit – Not permitted without written approval.
6. Rigid non-metallic conduit (RNC)
7. Polyvinyl Chloride conduit (PVC)
8. Outlet boxes.
9. Junction boxes.

10. Pull boxes.
11. Bushings.
12. Locknuts.
13. Knockout closures.

1.3 SUBMITTALS

A. Refer to Section 27 05 00 for requirements that shall be fulfilled as part of this specification section.

B. Product Data: This section does not have a “benchmark” product Appendix; thus, Contractor shall submit product data for all applicable products as required per Technology Drawings including, but not limited to:

1. Raceways and fittings.
2. Boxes and fittings.

C. Installation Instructions: Manufacturer’s written installation instructions for raceway products.

1.4 QUALITY ASSURANCE

A. In addition to Section 27 05 00 requirements, the following shall apply to this specification section.

1. NEMA Compliance: Comply with applicable requirements of NEMA standards pertaining to raceways.
2. NEMA Compliance: Comply with applicable requirements of NEMA Stds/Pub No.’s OS1, OS2 and PUB 250 pertaining to outlet and device boxes, covers and box supports.
3. Federal Specification Compliance: Comply with applicable requirements of FS W-C 586, “Electrical Cast Metal Conduit Outlet Boxes, Bodies, and Entrance Caps.”

PART 2 - SYSTEM REQUIREMENTS

2.1 METAL CONDUIT AND TUBING

A. Electrical Metallic Tubing (EMT) and Fittings: ANSI C80.3.

1. EMT shall be used for standard device outlet raceway, unless otherwise noted.
2. EMT shall be used for backbone conduit sleeves stubbed through floors.

B. Intermediate Metallic Conduit (IMC) and Fittings:

1. IMC shall be used for device outlets mounted below 10-ft in high traffic areas such as parking, loading docks, etc.
2. IMC shall be used for extending service entrance cable from building point of entrance to termination or transition point when the distance exceeds 50 feet.

C. Rigid Metallic Conduit (RMC) and Fittings:

1. RMC shall be used for device outlets located in areas exposed to weather/elements.
2. RMC shall be used for device outlets mounted below 10-ft in high traffic areas such as parking, loading docks, etc.
3. RMC shall be used for extending service entrance cable from building point of entrance to termination or transition point when the distance exceeds 50 feet.

D. Flexible Metal Conduit: UL 1, zinc-coated steel.

1. Flexible metal conduit shall only be used in locations proposed by the Contractor and specifically reviewed and approved by the Engineer.
2. Flexible conduit shall not exceed 6-feet in length before transitioning to rigid conduit unless specifically reviewed and approved by the Engineer. For distances exceeding 6-feet, provide flexible conduit that is one trade size larger.

E. Liquid-tight Flexible Metal Conduit and Fittings: UL 360.

1. Liquid-tight flexible metal conduit shall only be used in locations proposed by the Contractor and specifically reviewed and approved by the Engineer.
2. Flexible conduit shall not exceed 6-feet in length before transitioning to rigid conduit unless specifically reviewed and approved by the Engineer.

2.2 NON-METALLIC CONDUIT AND DUCTS

A. Conduit, Tubing and Duct Accessories: Types, sizes and materials complying with manufacturer's published product information. Mate and match accessories with raceway.

B. Electrical non-metallic tubing (ENT): NEMA TC13 and UL1653.

2.3 CONDUIT BODIES AND FITTINGS

A. General: Types, shapes, and sizes as required to suit individual applications and NEC requirements. Provide matching covers with gaskets secured with corrosion-resistant screws.

B. Metallic Conduit and Tubing: Use metallic conduit bodies. Use bodies with threaded hubs for threaded raceways. Use conduit bodies conforming to UL514B.

C. EMT Conduit Bodies: Use bodies with steel set screw connectors and couplings for interior applications and steel compression gland connectors and couplings for exterior applications.

D. Non-metallic Conduit and Tubing: Use non-metallic conduit bodies conforming to UL514B.

E. Liquid-Tight Flexible Conduit Fittings – Not permitted without written approval: With threaded grounding cone, a metallic, nylon or equal plastic compression ring, and a gland for tightening. Either steel or malleable iron only with insulated throats and male thread and locknut or male bushing with or without O-ring seal. Each connector shall provide a low resistance ground connection between the flexible conduit and the outlet box, conduit or other equipment to which it is connected.

F. Bushings: Insulated type, designed to prevent abrasion of wires without impairing the continuity of the conduit grounding system, for rigid metallic conduit, IMC and EMT, larger than 3/4-inch size.

G. Expansion Fittings: Each conduit that is buried in or secured to the building construction on opposite sides of a building expansion joint and each long run of exposed conduit that may be subject to excessive stresses shall be provided with an expansion fitting. Expansion fittings for rigid metallic conduit shall be hot-dipped galvanized malleable iron with factory installed packing and a grounding ring. Expansion fittings for rigid non-metallic conduit shall be of the short type in runs 25-feet (7.6m) or less, and the long type in runs 26 to 80-feet (7.9 to 24.3m). The long type shall be a two-piece barrel and piston joint, providing 6-inch (150mm) of the total movement range in 3/4-inch (19mm) through 6-inch (150mm) conduit sizes. The short type shall be a one piece, coupling with O-ring, providing 2-inch (50mm) of total movement range in 3/4 to 2-inch (19 to 50mm) conduit sizes.

H. Seal Off Fittings: Threaded, zinc or cadmium coated, cast or malleable iron type for metallic conduits. Fittings used to prevent passage of water vapor shall be of the continuous drain type.

2.4 FABRICATED MATERIALS - BOXES

A. Device Outlet Back-Boxes: Provide galvanized flat rolled sheet steel outlet wiring boxes, of shapes, cubic inch capacities, and sizes (two-gang, 4 11/16-inch x 4 11/16-inch 2 1/8-inch deep (120mm x 120mm x 54mm)), including box depths as required, suitable for installation at respective locations. Construct outlet boxes with mounting holes, and with cable and conduit-size knockout openings in bottom and sides. Provide boxes with threaded screw holes, with corrosion resistant cover and grounding screws for fastening surface and device type box covers, and for equipment type grounding.

1. Outlet Box Accessories: Provide outlet box accessories as required for each installation, including box supports, mounting ears and brackets, wallboard hangers, box extension rings, fixture studs, cable clamps and metal straps for supporting outlet boxes, which are compatible with outlet boxes being used to fulfill installation requirements for individual wiring situations. Choice of accessories is Installer’s code-compliance option.
2. Outlet Box Device Covers: Provide box covers as an individual component. In no instance shall a pre-fabricated box with a fixed box cover be utilized. All device covers shall be inter-changeable in the field based on openings requirements at respective locations. Box covers shall not be used as the box mounting bracket or as the mounting mechanism.

B. Rain-tight and Weatherproof Outlet Boxes: Weatherproof devices shall be provided at all exterior locations and any location susceptible to water and other exterior conditions. Provide corrosion-resistant cast-metal rain-tight outlet wiring boxes, of types, shapes and sizes, including depth of boxes, with threaded conduit holes for fastening telecommunications conduit, cast-metal and plastic face plates with spring-hinged watertight covers (polycarbonate) suitably configured for each application, including face plate gaskets and corrosion-resistant plugs and fasteners. Watertight cover shall allow for patch cords to be plugged in and sealed while in operation.

C. Junction and Pull Boxes: Provide galvanized code-gauge sheet steel junction and pull boxes, with screw-on covers; of types, shapes, and sizes, to suit each respective location and installation; with welded seams and equipped with stainless steel nuts, bolts, screws, and washers. Pull boxes installed in finished spaces must be flush mounted cabinets provided with trim, hinged door and flush latch and lock to match flush mounted panel board trim. Exact size shall meet minimum industry standards based on conduit quantities and stacking arrangement, as indicated in the table below:

Conduit Trade Size mm (in)	Width mm (in)	Length mm (in)	Depth mm (in)	Width Increase for Additional Conduit mm (in)
27 (1)	101 (4)	406 (16)	76 (3)	51 (2)
35 (1-1/4)	152 (6)	508 (20)	76 (3)	76 (3)
41 (1-1/2)	203 (8)	686 (27)	101 (4)	101 (4)
50 (2)	203 (8)	914 (36)	101 (4)	127 (5)
63 (2-1/2)	254 (10)	1067 (42)	127 (5)	152 (6)
78 (3)	305 (12)	1220 (48)	127 (5)	152 (6)
91 (3-1/2)	305 (12	1370 (54)	152 (6)	152 (6)
100 (4)	381 (15)	1525 (60)	203 (8)	203 (8)

D. Bushings, Knockout Closures and Locknuts: Provide corrosion-resistant box knockout closures, conduit locknuts and malleable iron conduit bushings, offset connectors, of types and sizes, to suit respective installation requirements and applications.

E. AV / Broadcast Box – Exterior Wall Semi-Flush – Refer to Appendix 1:

1. Equipped with 14GA front door on lift-off hinges.
2. Dimensions: 22” W x 22” H x 10” D
3. Cable Pass Through (CPT) Seal: Closed cell neoprene rubber.
4. Drip Shield.
5. 304 Stainless or Cold Rolled Steel 16GA, Brush Finish.
6. 19” Rack Mounts, 12GA.
7. Standard ¼ turn latches with locking cylinders.

PART 3 - EXECUTION

3.1 WIRING METHOD

A. Indoors: Use the following installation methods:

1. Exposed (below 10 ft. to floor): Intermediate metal conduit, rigid metal conduit.
2. Exposed (above 10 ft. or in electrical room): Electrical metallic tubing.
3. Concealed: Electrical metallic tubing.
4. Within concrete slabs: electrical non-metallic tubing or rigid non-metallic conduit. Homeruns shall be in conduit. Maximum sizes and locations as approved by the Structural Engineer.
5. Service entrance extension beyond 50-feet: Intermediate metal conduit, rigid metal conduit.

3.2 INSTALLATION OF RACEWAYS

A. General: Install telecommunications raceways in accordance with manufacturers' written installation instructions, applicable requirements of NEC, NEMA, ANSI, TIA, BICSI, and as follows.

1. Telecommunications service entrance cables that extend beyond 50-feet from the building point of entrance shall be in IMC or RMC from the point of entrance to the point of termination without breaks as require by the NEC.
2. Complete installation of telecommunications raceways before starting installation of conductors within raceways.
3. Elevation of Raceway: Where possible, install horizontal raceway runs above water and steam piping.
4. Provide supports for raceways as specified elsewhere in Electrical and/or Communications specification sections and in accordance with NEC and local authorities' seismic requirements.
5. Prevent foreign matter from entering raceways by using temporary closure protection.
6. Install pull lines or tape in empty raceways with three feet extending from each end, knotted and secured to remain in place. For indoor applications, use pull line having not less than 200-lb tensile strength. For outdoor applications use pull tape or wire having not less than 1200-lb tensile strength.

B. Labeling:

1. The final labeling scheme shall be coordinated with Owner, Architect, and Engineer prior to finalizing and initiating any work. A sample scheme shall be submitted for approval.
2. Refer to Specification Section 27 05 00 for additional requirements that shall be fulfilled as part of this specification section.

C. Clearances: Telecommunications raceway shall be routed to maintain appropriate clearances from potential interfering electrical sources per NEC, NEMA, ANSI, TIA, and BICSI requirements. Provided below are minimum requirements of key components that shall be maintained. For any instances where field conditions do not allow for the minimum clearances, the Contractor shall notify the Architect and Engineer so that an acceptable solution can be coordinated.

1. 120V Power Conduits: 6-inches (150mm)
2. 208V and Higher Power: 24-inches (600mm)
3. Lighting System: 12-inches (300mm)
4. Transformers: 48-inches (1200mm)
5. Motors and Fans: 48-inches (1200mm)
6. Other Interfering Sources to be field verified and coordinated by Contractor with Architect and Engineer.

D. Unobstructed Cabling Pathways: Raceway installer shall provide conduit sleeves through all walls and continuous segments above inaccessible ceiling spaces to ensure unobstructed cable pathways are provided from each device location back to the appropriate HC. (Refer to Technology Drawings for additional information.)

E. Horizontal Distance Limitations:

1. Communications horizontal cabling shall not exceed a total cable length of 295-feet (90m) for the permanent basic link. The channel length shall not exceed 325-feet (100m) when patch cords are installed.

2. Contractor(s) responsible for providing the communications horizontal raceway shall ensure that unobstructed pathway to each device location does not cause cable to exceed 295-feet (90m) length from to the nearest horizontal cross-connect (HC) location. This may require unobstructed pathway to be no more than 250-ft (76m) to accommodate necessary cable slack. Contractor shall bring any distance concerns to the attention of the Architect and Engineer during the bid process and/or at a minimum during the shop drawing process, prior to installation.

F. Daisy Chaining of pathways shall not be allowed unless specifically noted on the drawing or detailed on drawings. Each backbox shall be installed with a dedicated pathway. Any proposed or required daisy chaining will be detailed in contractor shop drawings and submittals and approved prior to installation. Any remediation to dedicated pathways as required will be the total responsibility of the Contractor at no additional cost to Owner.

G. In-slab Raceways: Raceways embedded in slabs shall only be permitted with the strict written approval of the Structural Engineer and Architect. For bidding purpose, conduit shall not be permitted in slab with exception of raceways specifically indicated on drawings or details to be in slab (such as on-grade floor box conduits).

H. Conduit Bends and Fittings:

1. Telecommunications conduits shall maintain large radius bends and sweeps. Use electrical 45º or 90º conduit elbows with long bend radii. Provided below are the ratios for minimum conduit bend radius to conduit size diameter:

   a. 6:1 bend radius of the inside conduit diameter for conduit sizes less than 2-inches.
   b. 10:1 bend radius of the inside conduit diameter for conduit sizes equal to or greater than 2-inches.

2. Protect stub-ups from damage where conduits rise from floor slabs. Arrange so curved portion of bends is not visible above the finished slab. All elbow penetration through the slab shall be PVC coated rigid metallic conduit Ells.
3. Make bends and offsets so the inside diameter is not effectively reduced. Unless otherwise indicated, keep the legs of a bend in the same plane and the straight legs of offsets parallel.
4. Use raceway fittings that are of types compatible with the associated raceway and suitable for the use and location. For intermediate metallic conduit, use threaded rigid steel conduit fittings except as otherwise indicated.
5. Run concealed raceways with a minimum of bends in the shortest practical distance considering the type of building construction and obstructions except as otherwise indicated.
6. Telecommunications raceways shall have a maximum pulling length of 100 feet and a maximum 180º total sum of all elbows, sweeps and bends for each pulling length. The maximum bend for any location shall not exceed 90º and a maximum of two 90º bends or equivalent shall be allowed. Pull-boxes or junction-boxes shall be provided where necessary to comply with these requirements.
7. Pull boxes shall be provided in straight sections of conduit only. Pull boxes shall not be used to change pathway direction in any locations.
8. Conduit outlet bodies (i.e., condulet, C, LB, LL, LR, T), shall not be used as cable pull points or to change pathway direction in any locations. These devices are commonly used for electrical/power pathways and are not approved for low voltage cabling.

9. Install raceway sealing fittings in accordance with the manufacturer's written instructions. Locate fittings at suitable, approved, accessible locations and fill them with UL-listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings at the following points and elsewhere as indicated:

    a. Where conduits pass from warm locations to cold locations, such as the boundaries of refrigerated spaces, air-conditioned spaces and walk-in coolers.
    b. Where required by the NEC.

10. Stub-up Connections: Extend conduits through concrete floor for connection to freestanding equipment with an adjustable top or coupling threaded inside for plugs and set flush with the finished floor. Extend conductors to equipment with rigid metallic conduit. Where equipment connections are not made under this contract, install screwdriver-operated threaded flush plugs flush with floor.
11. Flexible connection – Not permitted without written approval: Use flexible conduit with a maximum length of 6-feet (3m) for furniture feeds. Use liquid-tight flexible conduit in wet locations. Install separate equipment grounding conductor across flexible connections.
12. Join raceways with fittings designed and approved for the purpose and make joints tight. Where joints cannot be made tight, use bonding jumpers to provide electrical continuity of the raceway system. Make raceway terminations tight. Where terminations are subject to vibration, use bonding bushings or wedges to assure electrical continuity. Where subject to vibration or dampness, use insulating bushings to protect conductors. Use expansion fittings at building expansion joints.
13. Tighten set screws of threadless fittings with suitable tool.
14. Terminations: Where raceways are terminated with locknuts and bushings, align the raceway to enter squarely and install the locknuts with dished part against the box. Where terminations cannot be made secure with one locknut, use two locknuts, one inside and one outside of the box. All conduit connections to junction boxes shall have insulated bushings.
15. Where terminating in threaded hubs, screw the raceway or fitting tight into the hub so the end bears against the wire protection shoulder. Where chase nipples are used, align the raceway so the coupling is square to the box, and tighten the chase nipple so no threads are exposed.
16. PVC externally coated rigid steel conduit: Use only fittings approved for use with that material. Patch all nicks and scrapes in PVC coating after installing conduit.

I. Aesthetic Requirements:

1. Conceal conduit and EMT, unless indicated otherwise, within finished wall, ceilings, and floors. Keep raceways at least 6-inches (150mm) away from parallel runs of flues and steam or hot water pipes. Install raceways level and square and at proper elevations.
2. Install exposed raceways parallel and perpendicular to nearby surfaces or structural members and follow the surface contours as much as practical. All exposed conduit runs shall be approved by the Architect prior to installing.
3. Run exposed, parallel, or banked raceways together. Make bends in parallel or banked runs from the same center line so that the bends are parallel. Factory elbows may be used in banked runs only where they can be installed parallel. This requires that there be a change in the plane of the run such as from wall to ceiling and that the raceways be of the same size. In other cases, provide field bends for parallel raceways. All exposed conduit routing shall be approved by the Architect prior to installing.
4. All exposed conduits in public areas shall be painted to match surrounding walls as indicated within Architectural construction documents (drawings and specifications). Verify exact color with the Architect. Painting specified herein shall be provided by others.

3.3 INSTALLATION OF ELECTRICAL BOXES AND FITTINGS

A. General: Install electrical boxes and fittings in accordance with manufacturer's written instructions, applicable requirements of NEC and NECA's "Standard of Installation," and in accordance with recognized industry practices to fulfill project requirements.

B. Coordinate installation of electrical boxes and fittings with wire/cable, wiring devices, and raceway installation work.

C. Provide rain-tight or weatherproof covers for all communications device outlets at all interior and exterior locations exposed to weather or moisture.

D. Provide knockout closures to cap unused knockout holes where blanks have been removed.

E. Install electrical boxes in those locations which ensure ready accessibility to enclosed electrical wiring.

F. Installing boxes back-to-back in walls shall not be permitted. Provide no less than 12-inches (150mm) of separation.

G. Position recessed outlet boxes accurately to allow for surface finish thickness.

H. Do not use round boxes where conduit must enter box through side of box, which would result in difficult and unsecure connections when fastened with locknut or bushing on rounded surfaces.

I. Fasten telecommunication and electrical boxes firmly and rigidly to substrates, or structural surfaces to which attached, or solidly embedded electrical boxes in concrete or masonry.

J. Tap and splices, where permitted by these specifications within exterior junction boxes, shall be performed with an encapsulating watertight splice or tap kit which insulates, and moisture seals, the connection. Kit shall consist of the appropriate size and type mold, encapsulating resin and end sealing tape.

K. Subsequent to installation of boxes, protect boxes from construction debris and damage.

L. Outlet back-boxes shall be installed straight on walls to provide a neat appearance of faceplates on finished walls.

3.4 GROUNDING

A. Upon completion of installation work, properly ground telecommunications boxes and demonstrate compliance with requirements.

3.5 ADJUSTING AND CLEANING

A. Upon completion of installation of raceways, inspect interiors of raceways; clear all blockages and remove burrs, dirt, and construction debris.

END OF SECTION

APPENDIX 1 – EQUIPMENT SCHEDULE

General Notes:

1. There is no product number appendix for this section except as shown as Table 1 below.
2. Submit other proposed raceway and box products described within this specification and shown on the Technology Drawings along with the related Division 26 product submittals.
3. This specification is intended to be performance based, with the expectation that an “end-to-end” solution is provided by one of the “pre-approved” manufacturers (or partnerships) listed below.
4. Products listed below are intended to establish “benchmark” products from one or more of the “pre-approved manufacturers”. The listed benchmark products shall be used as a baseline when submitting products from a pre-approved manufacturer that does not have specific products listed.
5. Pre-approved manufacturers (listed in alphabetical order) include:
   a. Bulloch

Table 1 - Telecom Boxes for AV / Broadcast			
Item	**Part Name/Description**	**Manufacturer**	**Part Number**
1	AV / Broadcast Box - Exterior Wall Semi-Flush		
		Bulloch	AV-RP-22x22x10-CPT-DS-SS-S

APPENDIX 2 - SPECIFICATION COMPLIANCE MATRIX TEMPLATE

Indicate compliance of the proposed equipment and/or services by the word "Comply" following each paragraph number. Indicate an exception to the requirement by the word "Exception" following the applicable paragraph number. Should the proposed equipment and/or services not entirely comply with the requirements specified, but ultimately achieve the intent, the Bidder shall explain fully the extent, or lack thereof, of compliance for the applicable equipment and/or services proposed. Instances where there is no indication of compliance or exception shall be considered non-compliant.

Contractor shall submit Compliance Matrix with the Bid Proposal AND at the time of Product Data submittal (as indicated previously in this specification) so that a complete system submittal reviewed can be performed. Contractor shall use the following template to create a full Compliance Matrix for each specification section including Parts 1, 2 and 3.

	COMPLIANCE	**EXPLANATION**
PART 1		
1.1		
A	COMPLY	
B	EXCEPTION	Note clarifications and/or reason for exception here.
C	COMPLY	
1.2		
A.1	COMPLY	
A.2	COMPLY	
B	COMPLY	
C.1	COMPLY	
C.2	COMPLY	
D.1a	COMPLY	
D.1b	COMPLY	
D.2a	COMPLY	
xx	COMPLY	
xx	COMPLY	

This page is intentionally left blank.

SECTION 27 05 36 - CABLE TRAYS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Product Appendix: Refer to Appendix 1, Equipment Schedules, at the end of this section, for specific product information on the benchmark products. These equipment schedules should be the baseline for product data submittals but are not intended to be an all-encompassing bill of materials, unless noted otherwise.

B. Refer to Section 27 05 00 (Part 1 and Part 3) for requirements that shall be fulfilled as part of this specification section.

C. General provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections.

D. Architectural, Electrical, and Technology Drawings. Other systems drawings may apply.

E. Division 26 Specifications. Coordinate Electrical System requirements. Basic Electrical Materials and Methods sections apply to work of this section.

F. Rough carpentry is specified in a Division 6 section.

1.2 SUMMARY

A. Extent of cable tray system work is indicated by drawings. Cable trays are defined to include, but not limited to, supports, straight sections, reducers, bends, tees, crosses, elbows, covers, dividers and other applicable accessories.

B. Types of cable tray systems required for project include the following:

1. Wire Basket type.
2. Horizontal and Vertical cable runway routed within Communications Rooms is specified in specification section 27 11 00.

1.3 SUBMITTALS

A. General Description and Requirements

1. Refer to Section 27 05 00 for requirements that shall be fulfilled as part of this specification section.

B. Product Data:

1. Refer to Section 27 05 00 for requirements that shall be fulfilled as part of this specification section.

C. Shop Drawings and As-Built Drawings shall include:

1. Floor Plans: Provide scaled building floor plan drawings (with current reflected ceiling plan layer shown) based on architectural background indicating installation of cable tray systems and accessories including clamps, brackets, hanger rods, splice plate connectors, expansion joint assemblies and fittings. Plans shall show accurately scaled components, mounting heights/elevations, and spatial relationships (clearances) to adjacent structure and equipment, including but not limited to, HVAC ductwork, piping, and light fixtures. Shop drawings shall clearly indicate areas with cable tray clearance limitations and/or other cable access limitations for review and approval by Owner, Architect, and Engineer.
2. Details: Submit cable tray support detail drawings indicating installation of cable tray systems and accessories including clamps, brackets, hanger rods, splice plate connectors, expansion joint assemblies and fittings, and all grounding components.
3. Documentation: Provide submittals and documentation as required by the project manual (in addition to electronic copies) for review or as indicated in Division 1 general conditions.

PART 2 - SYSTEM REQUIREMENTS

2.1 CABLE TRAY SECTIONS AND COMPONENTS

A. General: Except as otherwise indicated, provide metal cable trays, of types, classes and sizes indicated; with splice plates, bolts, nuts and washers for connecting units; capable of supporting concentrated loads at any given point and maximum deflection of 1-inch (25mm) at full cable load, also indicated below. Construct units with rounded edges and smooth surfaces; in compliance with applicable standards; and with the following additional construction features:

1. Wire Basket Type

a. Tray Material: ASTM A510 high strength steel wires.
b. Cross Rungs: Standard 2-inch (50mm) x 4-inch (100mm) wire mesh pattern.
c. Bends and Fittings: 24-inch (600mm) minimum radius.
d. Construction: Steel wire side flanges and rounded wire ends. Carbon Steel ASTM A510 Grade 1008.
e. Tray Finish: ASTM B633 Electrozinc (Interior Locations).
f. Lengths shall not exceed 10’-0” (3.0m).
g. Loading Criteria: Cable tray supports shall be provided per manufacturer recommendations to meet the following minimum loads:

1) Point Load Rating: 50-lb (0.23 kN) at any given point.
2) Continuous Load Rating: 50-lb/ft (0.75 kN/m).

h. Supports: Cable tray supports shall be provided for each section and/or fitting and shall comply with NEMA VE-2 installation guidelines for maximum distance from support to the end of each section and/or fitting. Aircraft cable shall not be permitted as a means of supporting cable tray. Additionally, cable tray shall not be supported with center mount trapeze supports.

2.2 CABLE TRAY ACCESSORIES

A. Provide all necessary cable tray accessories as per manufacturer recommendations including, but not limited to, items described below and or indicated within cable tray details.

B. Provide all grounding and bonding components including, but not limited to, conductors, jumpers, clamps, etc. as recommended by cable tray manufacturer in order to maintain electrical continuity in the cable tray system.

C. Provide dropouts (waterfalls), conduit adapters, hold-down devices and blind ends, as indicated, and as recommended by cable tray manufacturer. Dropouts shall be provided for all cable tray segments that provide a vertical cable transition point (i.e., where cable tray dead-ends into a Communications Room, transitions to vertical cable tray, transitions to horizontal cable tray at a different elevation, etc.).

D. Provide pull-strings through any cable tray segment that has limited clearance accessibility, to ensure cables can be installed. Pull-strings shall be provided for each section when cable tray dividers are provided.

E. Provide divider strips constructed of metals and finishes which mate and match cable trays as noted. As a minimum, provide two (2) divider strips for all cable tray segments, unless cable tray details indicate more than two.

F. Provide cable tray covers (where applicable per drawings) constructed of metals and finishes which mate and match cable trays as noted.

2.3 SUPPORTS AND CONNECTORS

A. Provide all necessary cable tray support mechanisms as per manufacturer recommendations including, but not limited to, items described below and or indicated within cable tray details.

B. Provide cable tray supports and connectors as indicated within cable tray details, including but not limited to, uni-strut, trapeze mount threaded robs, wall mounted cantilever brackets, threaded rod protective sleeves, bonding jumpers, etc.

2.4 FIRESTOPPING - UL 1489

A. Provide firestopping pillows and/or bricks as required in all cable tray openings to maintain rating of the wall. Fireproofing shall consist of ready to use, intumescent fibrous material enclosed in a strong polyethylene envelope. Contractor shall assume this is to be included in the cable tray scope of work, unless directed otherwise by the Construction Manager and/or General Contractor.

PART 3 - EXECUTION

3.1 INSTALLATION OF CABLE TRAY SYSTEMS

A. Install cable trays in accordance with equipment manufacturer’s written instructions, and with recognized industry practices, to ensure that cable tray equipment complies with requirements. Comply with requirements of NEC 392, and applicable portions of NFPA 70B and NECA’s “Standard of Installation” pertaining to general electrical installation practices.

B. All walls where cable tray is installed with wall mounted brackets shall be internally reinforced as necessary at all bracket locations to support cable tray loads. Contractor shall coordinate this with the applicable trades in addition to the Architect and Engineer, prior to installing supports and/or cable tray at these locations.

C. Labeling:

1. The final labeling scheme shall be coordinated with Owner, Architect, and Engineer prior to finalizing and initiating any work. A sample scheme shall be submitted for approval.
2. Refer to Specification Section 27 05 00 for additional requirements that shall be fulfilled as part of this specification section.

D. Coordinate with other low voltage, electrical, and mechanical work as necessary to properly interface installation of cable tray work with other work.

E. Accessibility Clearances: Coordinate and provide cable tray clearances as indicated within the cable tray details and these specifications, to allow for appropriate accessibility for initial and future cable installation. Coordinate location of cable trays with all other trades to ensure clearances are obtained. For any instances where field conditions do not allow for the minimum clearances, the Contractor shall notify the Architect and Engineer so that an acceptable solution can be coordinated.

1. 18-24” W x 4” D Wire Basket Tray (Minimum Clearances):

   a. Side Access: 24” clearance on one side
   b. Top Access: 8” clearance above tray for continuous segments.

2. 8-12” W x 4” D Wire Basket Tray (Minimum Clearances):

   a. Side Access: 18” clearance on one side
   b. Top Access: 6” clearance above tray for continuous segments.

3. Exceptions: Cable tray segments may have limited clearances at intermittent crossings with structure or MEP systems. The following guidelines shall apply for such cases, provided there is clear access at both sides/ends of the conflict zone:

   a. For areas where conflict zones span up to an 8’-0” segment of tray, clearances of 6” between the top of the cable tray rail and the structural or MEP system will be permitted
   b. For areas where conflict zones consist of a beam, duct, conduits, or pipes crossing over a short segment of tray (3’-0” or less), clearances of 2-3” between the top of the cable tray rail and the structural or MEP system will be permitted.
   c. All other major cable tray conflict zones which may prevent the Contractor from maintaining appropriate cable tray clearances shall be reviewed with the Owner, Architect, and Engineer during the submittal process.

F. Electrical Clearances: Telecommunications raceway shall be routed to maintain appropriate clearances from potential interfering electrical sources per NEC, TIA, and BICSI requirements. Provided below are minimum clearance requirements of key components that shall be maintained.

1. 120V Power Conduits: 6-inches (150mm)
2. 208V and Higher Power: 12-inches (300mm)
3. Lighting System: 12-inches (300mm)
4. Transformers: 48-inches (1200mm)

5. Motors and Fans: 48-inches (1200mm)
6. Other Interfering Sources to be field verified and coordinated by Contractor with Architect and Engineer.

G. Cable Tray Grounding:

1. Ground cable trays according to NFPA 70 unless additional grounding is specified. Comply with requirements in Section 27 05 26.
2. Cable trays with powder-coat paint should have coating mask completely removed at factory supplied grounding locations and be spliced with listed connectors per manufacturer recommendation.
3. Electrically ground cable trays and ensure continuous electrical conductivity of cable tray system in accordance with manufactures instructions. Provide maximum of 1.0 ohms resistance to building ground connection. Provide equipment grounding connections, sufficiently tight to assure a permanent and effective ground.

H. Support cable tray per manufacturer recommendations to accommodate the loading criteria as indicated within this specification.

I. Provide UL listed “Firestopping” for all cable tray penetrations through fire rated walls and slabs according to Division 07 Section “Penetration Firestopping”. Install E90 certified cable tray for critical circuits, hallways, or in areas of egress as shown in drawings. Refer to Division 07 for additional requirements.

J. Wall openings that cable tray passes through that don’t require Firestopping per code shall be stopped or sealed to maintain the building envelope and/or acoustical requirements. Refer to architectural floor plans, details and specifications for additional requirements.

K. Remove burrs and sharp edges of cable trays, wherever these could possibly be injurious to wiring insulation or jacketing.

3.2 TESTING

A. Test cable trays to ensure electrical continuity of bonding and grounding connections, and to demonstrate compliance with specified maximum grounding resistance. Submit results to Engineer for approval.

3.3 WARNING SIGNS

A. After installation of cable trays is completed, install warning signs, either on or in proximity of cable trays, where easily seen by occupants of space, and indicating warning with following wording, “WARNING! NOT TO BE USED AS WALKWAY.” Provide 1-1/2”-high yellow lettering on black background, of style selected by Architect/Engineer. Temporary signage shall be installed during installation to notify other contractors that the tray shouldn’t be used as a walkway.

END OF SECTION

APPENDIX 1 - EQUIPMENT SCHEDULE

General Notes:
1. This specification is intended to be performance based, with the expectation that an “end-to-end” solution is provided by one of the “pre-approved” manufacturers (or partnerships) listed below.
2. Products listed below are intended to establish “benchmark” products from one or more of the “pre-approved manufacturers”. The listed benchmark products shall be used as a baseline when submitting products from a pre-approved manufacturer that does not have specific products listed.
3. Pre-approved manufacturers (listed in alphabetical order) include:
   a. Cablofil Legrand
   b. Hilti

Table 1 - Cable Tray (Wire Basket Type)			
Item	**Part Name/Description**	**Manufacturer**	**Part Number**
1	Wire Basket Tray - 4" deep		
		Legrand / Cablofil	CF105/XXXEZ
2	Horizontal / Vertical Bend Fitting Kits		
		Legrand / Cablofil	CE40EZ + WASHER-EZ
3	Cable Tray Drop-Out (Waterfall), Aluminum		
		Legrand / Cablofil	CABLEXIT
4	Cable Tray Dividers, Aluminum (Straight / Flexible / etc.)		
		Legrand / Cablofil	COT105 KITPG COT150 KITPG
5	Cable Tray Grounding Components		
		Legrand / Cablofil	GNDSB
6	Miscellaneous Components (Expansion / Splice plates, etc. as applicable)		
		Legrand / Cablofil	EDRNEZ
7	Cable Tray Support Components (as applicable)		
		Legrand / Cablofil	FASP
8	Fire Wall Sleeve Kit, Ladder Tray		
		Legrand / Cablofil	YM-WPS-XX-GE
9	Flexible Firestop Block		
		Hilti	CFS-BL

APPENDIX 2 - SPECIFICATION COMPLIANCE MATRIX TEMPLATE

Indicate compliance of the proposed equipment and/or services by the word "Comply" following each paragraph number. Indicate an exception to the requirement by the word "Exception" following the applicable paragraph number. Should the proposed equipment and/or services not entirely comply with the requirements specified, but ultimately achieve the intent, the Bidder shall explain fully the extent, or lack thereof, of compliance for the applicable equipment and/or services proposed. Instances where there is no indication of compliance or exception shall be considered non-compliant.

Contractor shall submit Compliance Matrix with the Bid Proposal AND at the time of Product Data submittal (as indicated previously in this specification) so that a complete system submittal reviewed can be performed. Contractor shall use the following template to create a full Compliance Matrix for each specification section including Parts 1, 2, and 3.

	COMPLIANCE	**EXPLANATION**
PART 1		
1.1		
A	COMPLY	
B	EXCEPTION	Note clarifications and/or reason for exception here.
C	COMPLY	
1.2		
A.1	COMPLY	
A.2	COMPLY	
B	COMPLY	
C.1	COMPLY	
C.2	COMPLY	
D.1a	COMPLY	
D.1b	COMPLY	
D.2a	COMPLY	
xx	COMPLY	
xx	COMPLY	

This page is intentionally left blank.

SECTION 27 11 00 - COMMUNICATIONS EQUIPMENT ROOM FIT-OUT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Product Appendix: Refer to Appendix 1, Equipment Schedules, at the end of this section, for specific product information on the benchmark products. These equipment schedules should be the baseline for product data submittals but are not intended to be an all-encompassing bill of materials, unless noted otherwise.

B. Refer to Section 27 05 00 (Part 1 and Part 3) for requirements that shall be fulfilled as part of this specification section.

C. General provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections.

D. Architectural, Structural, Mechanical, Electrical, and Technology Drawings. Other systems drawings may apply.

E. Division 26 Specifications. Coordinate Electrical System requirements. Basic Electrical Materials and Methods sections apply to work of this section.

F. Division 27 Specifications. Provide requirements in all corresponding Division 27 Specifications.

G. Rough carpentry is specified in a Division 6 section.

PART 2 - SYSTEM REQUIREMENTS

2.1 COMMUNICATIONS ROOM FIT-OUT

A. Communications Backboard

1. Plywood Backboard:

a. Provide 3/4-inch (19mm) AC grade plywood back board, void-free, rigidly fixed on communications walls as noted on drawings.
b. Plywood shall be mounted “A” side out, “C” side to the wall.
c. Shall conform to UL FR-S Plywood 1780 R-7003

1) Shall be fire retardant impregnated plywood OR
2) Plywood shall be painted with fire rated intumescent paint on all sides.

d. Shall be painted to match architectural finish (white minimum), fire rated plywood must be painted with intumescent paint to maintain rating.
e. Ensure that UL listing and Fire Rating stamp are left unpainted to allow inspector to verify the rating of the plywood.
f. If the UL stamp is on the “C” side of the plywood, contractor shall document via install and material progress photographs, delivery manifests and UL listing certifications to help satisfy potential inspector comments.

B. Communications Cabinets, Racks, Frames and Enclosures

1. General

a. Provide Equipment Cabinet and Rack types and sizes as shown on Technology Drawings. Refer to specific rack types described below for additional information.
b. Cabinets and/or racks shall be completely setup and installed all locations.
c. Cabinets and/or racks shall be vertically and horizontally level.
d. Cable distribution equipment cabinets and racks shall utilize 19-inch Standard / ETSI wide rack system. Cabinet post depths shall be adjustable.
e. Rack Mounting Holes: Pre-drilled and Threaded Tap Holes (spacing and diameter) or 3/8-inch (9.5mm) Square Punch with Cage Nuts per TIA standard pattern.
f. Bonding and Grounding. All cabinets and racks shall be grounded as described within Technology Drawings and specifications.

2. Equipment Cabinets – Network, Server, and AV Type:

a. Sizes: Per Specification Appendix 1 and Technology Drawings.
b. Frame: Lightweight Solid Aluminum Extrusion, Welded with Rail Depth Markings.
c. Vertical Mounting Rails: 19” with square holes, 42U or 47U to match cabinet size.
d. PDU Mounting Hardware – Lacing Bars or brackets.
e. Vertical Cable Management for Network/Server Cabinets – 42U Cable Fingers x 4.
f. Front Door: Full Width, 80% Perforated, Hinged (reversible), Removable with Locking Handles.
g. Rear Door: Split, 80% Perforated with Locking Handles.
h. Top: Roof Panels and Cover with Side Roof Brushes for Cable Access.
i. Side Panels: Solid, Removable and Lockable.
j. Interior Air Dams with Center Airflow seal.
k. Static Load Capacity: 3500-lb.
l. Fully configured and shipped with all components including bonding and grounding.
m. Base Levelers and Floor Anchor Brackets.

3. Equipment Cabinet – Vertical Wall-Mount Type:

a. Size: Per Specification Appendix 1 and Technology Drawings.
b. Rails: 4RU Fixed with Space for Additional Rail Kits.
c. Front Door: Solid, Split, Reversible and Locking.
d. Top Brush Grommet for Cable Access.
e. Cooling: Fan Kit, 2 Fans and Mounting Hardware.
f. Load Capacity: 150-lb overall.
g. Fully configured and shipped with all components and grounding.
h. Mounting Type: Mount to Wall. Provide all necessary wall support and reinforcement.

4. Equipment Rack – 4-post Cable Distribution and Network Type:

a. Size: Per Specification Appendix 1 and Technology Drawings.
b. Rails: 45 RU, 19-inch TIA Standard, All Adjustable after Rack Fastened to Floor.
c. Integrated Top Cable Management: Front and Rear waterfalls
d. Load Capacity: 2000-lb.
e. Mounting Type: Bolted to Floor with Neoprene Isolator.

5. Equipment Racks – 2-post Cable Distribution and Network Type:

    a. Rails: 45U, 19-inch TIA Standard.
    b. Channel: 6.5” D with Honeycomb side rails.
    c. Integrated Top Cable Management: Front and Rear waterfalls.
    d. Load Capacity: 2000-lb.
    e. Mounting Type: Bolted to Floor with Neoprene Isolator.

6. Equipment Cabinets and Racks – Accessories:

    a. Provide Accessories for equipment cabinets and racks as noted on drawings or within specifications, or as required to support specified system equipment.
    b. All accessories shall be completely setup and installed at locations shown on drawings, or as required to support specified systems equipment.
    c. All accessories shall be installed per manufacturer requirements.

C. Communications Termination Blocks and Patch Panels

1. All communications cables shall be terminated unless noted otherwise.
2. Cable terminations including wall fields, blocks, and patch panels are specified with in other sections.
3. Refer to 27 13 13 – Communications Copper Backbone Cabling, 27 13 23 – Communications Optical Fiber Backbone Cabling, and 27 15 01 – Communications Horizontal Cabling for additional requirements.

D. Communications Cable Management

1. General

    a. Horizontal cable tray shall be mounted around room perimeter and above equipment racks as indicated on drawings. Tray sections shall be offset a minimum of 6-inches (150mm) clear from wall (unless otherwise noted) to allow passage of other systems up wall including risers, backbone, and other distribution.
    b. Vertical ladder rack shall be placed on wall above riser conduit locations to support tie-off of backbone cables.
    c. Cable Tray sections shall be bonded together for electrical continuity (grounding) and system bonded to telecommunications ground bus (TGB) or electrical ground bus. Ladder rack, hardware, and components shall be UL classified.
    d. Cable Tray drop-outs shall be provided above all equipment racks and/or cabinets to allow for cable transition to termination panels.

2. Cable Tray – Ladder Type

    a. Cable racking in Communications Rooms shall be ladder rack with ASTM A513 and A570 structural tubular steel complete with all required mounting hardware and with all fittings and cables needed to form a bonded (grounded).

        1) Width: Refer to Technology Drawings.
        2) Side rails: 1½-inch x 3/8-inch (150mm x 9.5mm)
        3) Rungs: 9-inches (225mm) on-center
        4) Finish: Black Powder Coat.

3. Equipment Rack Vertical Cable Management:

    a. Provide high-capacity vertical cable managers on each side and between all equipment racks for cables and patch cord management.
    b. Sizes to be provided: per specification Appendix 1 and Technology Drawings.
    c. Vertical Cable Managers shall be compatible with equipment cabinets and racks with:

        1) Wire frame and rack unit finger design for patch cord routing between rakcs.
        2) Dual hinged slam latch doors.
        3) Cable management spools to provide slack storage fiber jumpers.
        4) Bend limiting clips for fiber entering vertical manager.

4. Equipment Cabinet/Rack Horizontal Cable Managers:

    a. Backbone and Horizontal patch panel cable managers: Provide 2U horizontal cable managers above, below, and between patch panels and data network switches for cables and patch cord management as shown in Technology Drawings.
    b. Cable Managers shall be compatible with equipment Cabinets and racks.
    c. Coordinate with the Owner to confirm the exact placement of these cable managers in the equipment racks.

5. Wall Field Cable Managers:

    a. Jumper troughs and cable managers shall be provided along each side and between wall fields or any other wall mounted cable terminals or patch panels. This is to provide adequate support of cables interconnecting wall fields or other wall mounted cable terminals.

6. D-Rings:

    a. D-Rings or equivalent means shall be provided as necessary on backboard to support any horizontal and vertical cables not supported by cable tray or other means.
    b. Spacing shall not exceed 24-inches (600mm) or cable manufacturer’s recommendation, whichever is less.

E. Communication Rack Mounted Power Protection and Power Strips

1. Rack Mounted Uninterruptible Power Systems (UPS)

    a. Dedicated “spot” UPS units will be mounted within cabinets and/or racks for communications rooms not fed by centralized UPS units.
    b. Unless noted otherwise on Technology Drawings or in another Division 27 specification section, cabinet and/or rack mounted UPS units and mounting hardware are provided by Owner and noted here for reference only.

2. Vertical Power Strips – Power Distribution Units (PDUs)

    a. Each equipment cabinet shall be installed with vertical power strips (PDUs) that have multiple power outlets to connect equipment within cabinet.
    b. Power strips shall have a cord with plug and shall be connected to specific receptacles on dedicated circuits.

c. Power strips shall be connected to different power sources or UPS wherever possible.
d. Mounting brackets shall be installed according to cabinet and/or power strip manufacturer recommendations to properly mount power strips within cabinet.
e. Unless noted otherwise on Technology Drawings or in another Division 27 specification section, cabinet and/or rack mounted power strips and mounting brackets are provided by Owner and noted here for reference only.

3. Horizontal Power Strips – Power Distribution Units (PDUs)

a. A minimum of (1) horizontal power strip shall be provided for each equipment rack location.
b. Power strips shall have a cord with a plug and shall be connected to specific receptacles on dedicated circuits.
c. Unless noted otherwise on Technology Drawings or in another Division 27 specification section, cabinet and/or rack mounted power strips and mounting brackets are provided by Owner and noted here for reference only.

F. Telecommunications Grounding Busbar (TGB)

1. Each Communications Room shall be installed with a dedicated telecommunications ground bus bar (TGB) and bonded to the telecommunications bonding backbone (TBB).
2. Each Equipment Cabinet, Equipment Rack, Ladder Rack or Wire Basket Tray, Conduit Sleeves, and other metallic components etc. shall be individually bonded and grounded to TGB. Overhead Ladder Rack or Basket Tray may have a single grounding connection to the ground bus bar, but shall have grounding jumpers provided between each segment (as required) for tray that does not have connectors which are UL listed for grounding.
3. Refer to Section 27 05 26 – Telecommunications Grounding and Bonding for additional requirements.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION

A. Refer to Section 27 05 00 for requirements that shall be fulfilled as part of this specification section.

B. Equipment Cabinet and/or Rack Installation:

1. Cabinets and racks shall be vertically and horizontally level.
2. Provide a junction plate at top of equipment rack and required cable runway to attach rack to cable runway around the perimeter of the Communications room. Junction plate must be fastened to frame without using “J”-hooks so that no equipment space is lost.
3. The completed equipment rack will be affixed to the floor using drop-in anchors and 5/8-inch zinc-plated hex bolts, split and flat washers.
4. All equipment and components noted in this section and drawings shall be provided and completely setup and installed. This includes but not limited to Cabinets and Racks, Cable Management and Ladder Rack, Communication Wall Fields and Patch Panels, and Communications Rack Mounted Power Protection and Power Strips.
5. All ladder cable runway shall be securely anchored to the walls (both ends) with support kits and brackets as specified by manufacturer and supported overhead at intervals by trapeze supported channel and rebar in PVC tubing.

6. All new cables shall be supported using overhead ladder rack, D- rings, and cable management hardware and shall be neatly dressed-out in the TRs.
7. All equipment shall be generally installed per drawings and field coordinated with current conditions and other trades. The final locations shall be coordinated with Owner, Architect, and Engineer prior to installation. No additional cost submitted by contractor shall be incurred by Owner due to Contractor's failure to comply with this requirement.

C. Drip Pans:

1. Drip Pans: Where possible to run mechanical, plumbing, fire suppression or similar "wet" piping elsewhere, do not run piping directly above technology work which is sensitive to moisture. If no other options exist and after confirmation review with Engineer and Owner, provide drip pans under all piping, sufficient to protect technology work from dripping.
2. Locate pan immediately below piping and extend a minimum of 6" on each side of piping and lengthwise 18" beyond equipment being protected.
3. Fabricate pans 2" deep of reinforced sheet metal with rolled edges and soldered or welded seams; 22 gauge galvanized steel. Provide 3/4" copper drainage piping from pan to nearest floor drain or similar suitable point of discharge and terminate pipe as an open-sight drainage connection.
4. Coordinate work with MEP Contractor.
5. Insulate bottom of pan and drainage pipe as directed by Engineer.

D. Labeling:

1. The final labeling scheme shall be coordinated with Owner, Architect, and Engineer prior to finalizing and initiating any work. A sample scheme shall be submitted for approval.
2. Refer to Specification Section 27 05 00 for additional requirements that shall be fulfilled as part of this specification section.

END OF SECTION

APPENDIX 1 - EQUIPMENT SCHEDULE

General Notes:
1. This specification is intended to be performance based, with the expectation that an “end-to-end” solution is provided by one of the “pre-approved” manufacturers (or partnerships) listed below.
2. Products listed below are intended to establish “benchmark” products from one or more of the “pre-approved manufacturers”. The listed benchmark products shall be used as a baseline when submitting products from a pre-approved manufacturer that does not have specific products listed.
3. Pre-approved manufacturers (listed in alphabetical order) include:
   a. Legrand / Ortronics

Table 1 - Equipment Cabinets, Racks, and Accessories			
Item	**Part Name/Description**	**Manufacturer**	**Part Number**
1	42U - Cabinet with Accessories for MDF (800mm W x 1200mm D) - Black for Judiciary With Side Panels and Door Swing as Indicated on Drawings		
		Legrand / Ortronics	Nexpand B1109-081242
2	42U - Cabinet with Accessories for MDF (800mm W x 1200mm D) - White for DGS With Side Panels and Door Swing as Indicated on Drawings		
		Legrand / Ortronics	Nexpand B1104-081242
3	42U - Cabinet with Accessories for IDF Rooms (800mm W x 1000mm D) - Black for Judiciary With Side Panels and Door Swing as Indicated on Drawings		
		Legrand / Ortronics	Nexpand B1109-081042
4	42U - Cabinet with Accessories for IDF Rooms (800mm W x 1000mm D) - White for DGS With Side Panels and Door Swing as Indicated on Drawings		
		Legrand / Ortronics	Nexpand B1104-081042
5	47U - AV Cabinet with Accessories for Court Recording and Training Rooms (600mm W x 1000mm D) - White - With Side Panels and Door Swing as Indicated on Drawings		
		Legrand / Ortronics	Nexpand B1104-061047
6	45U - 4-post Open Equipment Rack - Adjustable to 42" Depth		
		Legrand / Ortronics	MM20742ADJ12
7	45U - 2-post Equipment Rack (6-inch Channel)		
		Legrand / Ortronics	MM20706
8	Vertical Wall-Mount Cabinet for Penthouse and DEMARC Room - (42" H x 18" D) 8RU With Locking Door		
		Legrand / Ortronics	VWMSD-8RU-42-B VWMFK-115, VWMBGK
9	2U Horizontal Cable Manager		
		Legrand / Ortronics	MM20HMF2RU
10	6-inch wide Vertical Cable Manager		

Table 1 - Equipment Cabinets, Racks, and Accessories			
Item	**Part Name/Description**	**Manufacturer**	**Part Number**
		Legrand / Ortronics	MM20VMD706
11	10-inch wide Vertical Cable Manager		
		Legrand / Ortronics	MM20VMD710-X
12	Telecom Horizontal Ground Bar Kit for Cabinet / Rack - 1 x 19.25"		
		Legrand / Ortronics	GBH19KIT

Table 2 - Raceway and Accessories			
Item	**Part Name/Description**	**Manufacturer**	**Part Number**
1	XX-inch Ladder Rack Type Cable Tray (Black Powder Coat Finish)		
		Legrand / Ortronics	TRT10-XXB
2	Ladder Rack Triangular Support Bracket Aluminum XX-inch Wide (Black)		
		Legrand / Ortronics	P139540HB
3	Ladder Rack Suspended Mount Support Bracket Aluminum XX-inch Wide (Black)		
		Legrand / Ortronics	RCBK-6
4	Ladder Rack to Equipment Rack Support Brackets - Elevation Kit (Black)		
		Legrand / Ortronics	REK-4-6
5	12-inch Ladder Rack Radius Drop Out (Cross Member - Black)		
		Legrand / Ortronics	TRP11-CM
6	12-inch Ladder Rack Radius Drop Out (Stringer Member - Black)		
		Legrand / Ortronics	TRP8-S
7	Ladder Rack Butt-Splice Kit (Black)		
		Legrand / Ortronics	P820127H
8	Ladder Rack Junction Splice Kit (Black)		
		Legrand / Ortronics	P820147H
9	Ladder Rack Vertical Wall Brackets (Black)		

Table 2 - Raceway and Accessories			
Item	**Part Name/Description**	**Manufacturer**	**Part Number**
		Legrand / Ortronics	SUBMIT FOR APPROVAL
10	Equipment Grounding Components		
		Legrand / Ortronics	GS-8

APPENDIX 2 - SPECIFICATION COMPLIANCE MATRIX TEMPLATE

Indicate compliance of the proposed equipment and/or services by the word "Comply" following each paragraph number. Indicate an exception to the requirement by the word "Exception" following the applicable paragraph number. Should the proposed equipment and/or services not entirely comply with the requirements specified, but ultimately achieve the intent, the Bidder shall explain fully the extent, or lack thereof, of compliance for the applicable equipment and/or services proposed. Instances where there is no indication of compliance or exception shall be considered non-compliant.

Contractor shall submit Compliance Matrix with the Bid Proposal AND at the time of Product Data submittal (as indicated previously in this specification) so that a complete system submittal reviewed can be performed. Contractor shall use the following template to create a full Compliance Matrix for each specification section including Parts 1, 2 and 3.

	COMPLIANCE	**EXPLANATION**
PART 1		
1.1		
A	COMPLY	
B	EXCEPTION	Note clarifications and/or reason for exception here.
C	COMPLY	
1.2		
A.1	COMPLY	
A.2	COMPLY	
B	COMPLY	
C.1	COMPLY	
C.2	COMPLY	
D.1a	COMPLY	
D.1b	COMPLY	
D.2a	COMPLY	
xx	COMPLY	
xx	COMPLY	

SECTION 27 13 13 - COMMUNICATIONS COPPER BACKBONE CABLING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Product Appendix: Refer to Appendix 1, Equipment Schedules, at the end of this section, for specific product information on the benchmark products. These equipment schedules should be the baseline for product data submittals but are not intended to be an all-encompassing bill of materials, unless noted otherwise.

B. Refer to Section 27 05 00 (Part 1 and Part 3) for requirements that shall be fulfilled as part of this specification section.

C. General provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections.

D. Architectural, Electrical, and Technology Drawings. Other systems drawings may apply.

E. Division 26 Specifications. Coordinate Electrical System requirements. Basic Electrical Materials and Methods sections apply to work of this section.

F. Division 27 Specifications. Provide requirements in all corresponding Division 27 Specifications.

G. Rough carpentry is specified in a Division 6 section.

PART 2 - SYSTEM REQUIREMENTS

2.1 COMMUNICATIONS COPPER CABLING SYSTEM

A. Topology:

1. The Communications Copper Backbone Cabling will be an industry standard physical star topology with high pair count copper cabling interconnecting each Intermediate Cross-connect (IC) to the Copper Main Cross-Connect (MC) location, unless noted otherwise.
2. For conditions where backbone cable is provided to non-communication room locations, all cabling topology shall follow the same requirements and originate from the MC unless noted otherwise.
3. All cable splices shall be coordinated with Owner, Architect, and Engineer. This includes those shown on drawings and/or proposed by Contractor.
4. Cable splices are only acceptable as noted on the drawings and must be approved by Owner, Architect, and Engineer.
5. Cable splices are only intended where differing cable types are joined and/or multiple smaller cables are joined to larger backbone feeder cables.
6. Splices are not acceptable to extend cables of inadequate length.
7. Cables from different low voltage systems (ex. 70v Speaker, BMS, etc.) shall not be run in the same conduit pathways with copper backbone cabling unless specifically noted on the drawings.
8. Refer to drawings for additional requirements.

B. General Requirements

1. All cable and terminations shall meet the minimum Performance and Criteria listed in specification below and on drawings, in accordance with TIA-568-C.2.
2. Cable requirements including cable types, quantities and pair / strand counts are specified on the drawings.
3. All cables shall have the appropriate fire spread rating per building codes, industry standard, and Underwriters Laboratory (UL/cUL) including plenum (CMP/OFNP/OFCP), riser (CMR/OFNR/OFCR), etc. The contractor shall verify the appropriate cable is being used for application it is installed.
4. Any cable routed below grade shall utilize specific water block construction. Copper cables generally use gel-filled compound to achieve this rating. The contractor is required to submit a solution wherever this condition exists regardless of whether noted on drawings.
5. Underground rated cable that doesn't carry a suitable indoor building cable rating per building code and UL, shall not be routed more than 50-ft (15m) inside the building. Cable shall be spliced or terminated as appropriate and noted on drawings.
6. All armored and/or metallic cable sheaths shall be bonded to Telecommunications Ground Bus (TGB).

C. Performance and Criteria

1. General Copper Backbone Cabling Requirements: (as applicable per drawings)

a. Cable Rating:

1) Riser Rated (CMR) when installed in non-plenum spaces as determined by Authority Having Jurisdictions (AHJ).

b. Cable Construction:

1) Construction: Unshielded Twisted Pair
2) Medium: Solid Annealed Copper

c. Length Limitations: 2600-feet (800m) for telecommunications
d. Physical Specification:

1) Standard Cable Sizes: 25-pair per one-line drawings.
2) Conductor Size: 24 AWG

e. Compliances: Refer to respective cable types in section 2.2.
f. Electrical Specifications:

1) Characteristic Impedance: 100 Ohms
2) Cat 3 Frequency: 1-16 MHz
3) Cat 5 Frequency: 1-100 MHz

g. Temperature:

1) CMR Operating and storage: -4 to +140ºF (-10 to +60ºC)

h. Pulling Tensions (max): 25-lb (11 kg).
i. Transmission Performance: TIA Cat 3 or higher

2.2 CABLE REQUIREMENTS

A. General

1. The cables shall meet the minimum requirements noted in Performance and Criteria Section for each respective cable type based on TIA-568-C.2 equivalent cable rating.
2. Refer to Technology Drawings for all cable types, quantities and pair / strand counts.

B. Cat. 3 or Higher Riser Rated – Telecommunications Cables

1. Application: Building backbone and riser installation within duct, conduits or cable trays telecommunications backbone cable.
2. Construction:

a. Insulation: Flame retardant semi-rigid PVC.
b. Shield/Sheath: None.
c. Filling Compound: None.
d. Jacket: Flame retardant PVC.

3. Color: Gray.
4. Compliances: TIA-568-C.2, NEC/CEC Type CMR

2.3 TERMINATION REQUIREMENTS

A. General

1. Wiring terminals shall meet the minimum requirements noted in Performance and Criteria Section for each respective cable type, based on TIA-568-C.2 equivalent cable ratings.
2. Provide all necessary wiring terminals, jumper troughs, protector panel, ground wire and bonding to building ground, and plug in protectors (as applicable).
3. Temperature rating (unless noted otherwise):

a. Operating: +14 to +140ºF (-10 to +60ºC).
b. Storage: -40 to +158ºF (-40 to +70ºC).

B. Punchdown / RJ45-Type Patch Panel

1. General:

a. This wiring terminal shall meet the minimum requirements noted in Performance and Criteria Section for Category 5E.
b. Provide all necessary wiring terminals, horizontal cable manager, protector panel, ground wire and bonding to building ground, and plug in protectors.
c. Provide double-sided horizontal cable manager above and/or below patch panels as indicated on Technology Drawings (Rack Elevations).
d. Terminate pairs on patch panel per general notes on Technology Drawings (Copper Backbone One-line). Exact requirements shall be coordinated and approved with Owner, Architect, and Engineer prior to initiating any work.
e. Specific communication device and outlet types shall be grouped together on patch panel plus 20% spare jacks be added within grouping.

2. Type: Punchdown / RJ45-Type.
3. Mounting Configuration: 19-inch Rack mounted in Telecom Rooms (TRs)
4. Size: 24-port or 48-port (provide as required to terminate all cable).

5. Cable Interface:

    a. Input: 110-Type (back).
    b. Output: RJ45-Type (front).

6. Electrical Specifications:

    a. TIA-568-C.2: Category 3 or 5e to match cable type.
    b. Insulation Resistance: 500 MegaOhms (minimum).
    c. Current Rating: 1.5A @ 68ºF (20ºC).
    d. Dielectric Withstand Voltage: 1000 VAC RMS, 60Hz (minimum), contact-to-contact and 1,500 VAC RMS, 60Hz (minimum) to exposed conductive surface.
    e. UL and cUL Listed
    f. FCC Part 68

7. Plug Requirements:

    a. Retention Force: 30-lb (133N).
    b. Insertion Life: 750 minimum.
    c. Plug/Jack Contact Force: 0.22-lb (100g).

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION

A. Refer to Section 27 05 00 for requirements that shall be fulfilled as part of this specification section.

B. Labeling:

1. The final labeling scheme shall be coordinated with Owner, Architect, and Engineer prior to finalizing and initiating any work. A sample scheme shall be submitted for approval.
2. Each cable, patch panel, and termination shall be identified at the Main Cross-connect (MC), at the Intermediate Cross-connect (IC), and at each station termination.
3. Refer to Specification Section 27 05 00 for additional requirements that shall be fulfilled as part of this specification section.

C. Telecommunications Testing:

1. All communications copper backbone cabling and pairs shall be tested for electrical continuity and wire map.
2. All cabling will be test/certified for conformance to the TIA-568-C.2 Category 3 and Category 5 specifications (as applicable) using Level 2 test equipment in accordance with TIA-568-C.2.
3. Cable tests will be per industry standard and also include the following:

    a. Cable Length
    b. Attenuation
    c. NEXT
    d. Characteristic Impedance
    e. Mutual Capacitance
    f. Resistance
    g. Noise

h. Wire Map

4. Electronic test results shall be submitted by the Contractor for approval by Owner, Architect, and Engineer.

END OF SECTION

APPENDIX 1 - EQUIPMENT SCHEDULE

General Notes:
1. This specification is intended to be performance based, with the expectation that an “end-to-end” solution is provided by one of the “pre-approved” manufacturers (or partnerships) listed below.
2. Products listed below are intended to establish “benchmark” products from one or more of the “pre-approved manufacturers”. The listed benchmark products shall be used as a baseline when submitting products from a pre-approved manufacturer that does not have specific products listed.
3. Pre-approved manufacturers (listed in alphabetical order) include:
   a. Legrand / Ortronics
   b. Superior Essex

Table 1 - Copper Backbone Cable / Connectivity Products			
Item	**Part Name/Description**	**Manufacturer**	**Part Number**
1	25-pair Category 3 - Riser Rated Cable		
		Superior Essex	18-475-33 or 18-499-33
2	Category 5E RJ45 / 110-Punch Patch Panel (24-port)		
		Legrand / Ortronics	PHD5E6U24
3	Category 5E RJ45 / 110-Punch Patch Panel (48-port)		
		Legrand / Ortronics	PHD5E6U48

APPENDIX 2 - SPECIFICATION COMPLIANCE MATRIX TEMPLATE

Indicate compliance of the proposed equipment and/or services by the word "Comply" following each paragraph number. Indicate an exception to the requirement by the word "Exception" following the applicable paragraph number. Should the proposed equipment and/or services not entirely comply with the requirements specified, but ultimately achieve the intent, the Bidder shall explain fully the extent, or lack thereof, of compliance for the applicable equipment and/or services proposed. Instances where there is no indication of compliance or exception shall be considered non-compliant.

Contractor shall submit Compliance Matrix with the Bid Proposal AND at the time of Product Data submittal (as indicated previously in this specification) so that a complete system submittal reviewed can be performed. Contractor shall use the following template to create a full Compliance Matrix for each specification section including Parts 1, 2, and 3.

	COMPLIANCE	**EXPLANATION**
PART 1		
1.1		
A	COMPLY	
B	EXCEPTION	Note clarifications and/or reason for exception here.
C	COMPLY	
1.2		
A.1	COMPLY	
A.2	COMPLY	
B	COMPLY	
C.1	COMPLY	
C.2	COMPLY	
D.1a	COMPLY	
D.1b	COMPLY	
D.2a	COMPLY	
xx	COMPLY	
xx	COMPLY	

This page is intentionally left blank.

SECTION 27 13 23 - COMMUNICATIONS OPTICAL FIBER BACKBONE CABLING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Product Appendix: Refer to Appendix 1, Equipment Schedules, at the end of this section, for specific product information on the benchmark products. These equipment schedules should be the baseline for product data submittals but are not intended to be an all-encompassing bill of materials, unless noted otherwise.

B. Refer to Section 27 05 00 (Part 1 and Part 3) for requirements that shall be fulfilled as part of this specification section.

C. General provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections.

D. Architectural, Electrical, and Technology Drawings. Other systems drawings may apply.

E. Division 26 Specifications. Coordinate Electrical System requirements. Basic Electrical Materials and Methods sections apply to work of this section.

F. Division 27 Specifications. Provide requirements in all corresponding Division 27 Specifications.

G. Rough carpentry is specified in a Division 6 section.

PART 2 - SYSTEM REQUIREMENTS

2.1 COMMUNICATIONS OPTICAL FIBER BACKBONE CABLING SYSTEM

A. Topology:

1. The Optical Fiber Backbone Cabling will be an industry standard physical star topology with fiber optic cabling interconnecting each Intermediate Cross-connect (IC) to the Fiber Optic Main Cross-Connect (MC) location, unless noted otherwise.
2. For conditions where backbone cable is provided to non-communication room locations such as Remote Hub locations, all cabling topology shall follow the same requirements and originate from the MC unless noted otherwise.
3. Cable splices are only acceptable as noted on the drawings and must be approved by Owner, Architect, and Engineer.
4. Cable splices are only intended where differing cable types are joined and/or multiple smaller cables are joined to larger backbone feeder cables.
5. Splices are not acceptable to extend cables of inadequate cable lengths.
6. Refer to drawings for additional requirements.

B. General Requirements:

1. All cable and terminations shall meet the minimum Performance and Criteria listed in specification below and on drawings, in accordance with TIA-568-C.3.
2. Cable requirements including cable types, quantities and pair / strand counts are specified on the drawings.
3. All cables shall have the appropriate fire spread rating per building codes, industry standard, and Underwriters Laboratory (UL/cUL) including plenum (CMP/OFNP/OFCP), riser (CMR/OFNR/OFCR), etc. The contractor shall verify the appropriate cable is being used for application it is installed.
4. Any cable routed below grade shall utilize specific water block construction. Fiber optic cables can use dry water block tape or gel-filled compound to achieve this rating. The contractor is required to submit a solution wherever this condition exists regardless of whether noted on drawings.
5. Underground rated cable that doesn't carry a suitable indoor building cable rating per building code and UL, shall not be routed more than 50-ft (15m) inside the building. Cable shall be spliced or terminated as appropriate and noted on drawings.
6. Approved splices shall be low attenuation fusion type.
7. All armored and/or metallic cable sheaths shall be bonded to Telecommunications Ground Bus (TGB).
8. Fiber terminations shall swap transmit/receive polarity on far end of cable per industry standards for all mated or duplex connectors. This requirement shall be coordinated with Owner and Facility Operator.
9. Service loops shall be provided at each end of cable at the termination point.
10. Provide breakout or fan-out kits for all loose type fiber optic cables for transitioning to tight buffered cable at termination points.

C. Performance and Criteria:

1. General Fiber Backbone Cabling Requirements: (as applicable per drawings)

   a. Cable Rating:

      1) Riser Rated (CMR) when installed in non-plenum spaces as determined by Authority Having Jurisdictions (AHJ).

   b. Cable Construction:

      1) Construction: Interlocking Armored

   c. Length Limitations: Refer to tables below.
   d. Physical Specification:

      1) Strand Counts: 6, 12, and 24 as indicated on drawings.
      2) Multi-mode Core Diameter: 50-Micron
      3) Single-mode Core Diameter: 8-Micron
      4) Cladding Diameter: 125-Micron

   e. Compliances: Refer to respective cable types in section 2.2.
   f. Temperature:

      1) CMR Operating and storage: -4 to +140ºF (-10 to +60ºC)

g. Bend Radius (Minimum):

1) Installation: 20X Outside Cable Diameter.
2) Operating: 10X Outside Cable Diameter.

h. Pulling Tensions (max): 25-lb (11 kg).
i. Transmission Performance (min.)

1) Refer to tables below for each applicable cable type.

2. 50.0 – Micron Multi-Mode 550 (OM4)

a. Transmission Performance:

50.0 - MICRON MULTI-MODE (OM4)						
Wavelength	**Maximum**	**Bandwidth**	**Supported Ethernet Length**			
	Attenuation	**(MHz-km)**	**10 Mbps**	**100 Mbps**	**1 Gbps**	**10Gbps**
850 nm	3.5 dB/km	4700 MHz-km	980-feet (300m)	980-feet (300m)	3600-feet (1100m)	1800-feet (550m)
1300 nm	1.5 dB/km	500 MHz-km	6560-feet (2000m)	6560-feet (2000m)	1960-feet (600m)	980-feet (300m)

3. 8.3 – Micron Single-Mode (OS2)

a. Fiber Category G.652.D/G.657.A1
b. Maximum Attenuation 0.4 dB/km / 0.4 dB/km / 0.4 dB/km
c. Wavelengths 1310 nm / 1383 nm / 1550 nm

2.2 CABLING

A. General

1. This cable shall meet the minimum requirements noted in Performance and Criteria Section for each respective cable type based on ANSI/TIA/EIA-568-C.3 equivalent cable rating.
2. Refer to Technology Drawings for all cable types, quantities and pair / strand counts.

B. Interlocking Armored Building Cables

1. Riser Rated (CMR / OFCR)

a. Application:

1) Building Cable is intended for interior building backbone and riser distribution installation within duct, conduits, and/or cable tray.

b. Construction:

1) Jacket: Flame Retardant, Riser Rated, (CMR / OFCR)
2) Fiber Buffer: Tight Buffered, 900-micron.
3) Armor: Interlocking Aluminum.
4) Strength Member: Aramid Strength Yarn.
5) Water Block/Filling Compound: None.

c. Compliances:

1) ANSI/TIA/EIA-568-C.3
2) NEC/CEC Type CMR / OFCR.

2.3 TERMINATION EQUIPMENT

A. General

1. Fiber terminations shall meet the minimum requirements noted in Performance and Criteria Section for each respective cable type, based on ANSI/TIA/EIA-568-C.3 equivalent cable ratings.
2. Provide all necessary fiber enclosures, splice trays, and connectors (as applicable). Refer to Technology Drawings for additional information.

B. Termination Type Requirements

1. Benchmark: Provide pre-terminated fiber module with pigtail for fusion splicing, mounted within splice tray.
2. Alternate Options: Contractor may elect to provide alternate pricing for consideration (but at the sole discretion of Owner and Engineer) for either of the following options:

a. Pre-polished, field terminated connectors with adapter pack (i.e., bulk heads)
b. Field-polished, field terminated connectors with adapter pack (i.e., bulk heads)

C. Connectors

1. General:

a. Ferrule: Ceramic
b. Fiber Buffer Size: 900-micron
c. Optical Specification:

1) Multi-mode
2) Single-mode
3) Insertion Loss (Typical / Max.): <0.3dB / <0.75dB

d. Plug Requirements:

1) Retention Force (Buffer): 2-lb (0.9kg)
2) Retention Force (Cordage): 10-lb (4.5kg)
3) Insertion Life: 500 minimum.

e. Temperature rating (operating): -40 to +167ºF (-40 to +75ºC).

2. LC-Type / UPC

a. Application / Fiber Type:

1) Multi-mode
2) Single-mode

b. Form Factor: Small Form Factor (SFF)
c. Adapter Type: Duplex or Simplex

d. Polish: Ultra Physical Contact (UPC)

3. ST-Type – For Broadcast Only

a. Application / Fiber Type:

1) Single-mode

b. Adapter Type: Simplex

D. Splice Trays

1. General:

a. Shall meet the minimum requirements noted in Performance and Criteria Section.
b. Dedicated splice trays may not be necessary as enclosures with built in splice trays may be acceptable, if submitted and accepted by Owner / Engineer.

2. Application:

a. Provide protection and slack management of heat shrink fusion spliced fibers.
b. Splice tray to be used with enclosures noted below.

3. Fiber Types supported:

a. Micron Multi-Mode (OM4)
b. Micron Single-Mode (OS2)

4. Sizes / Fiber Counts supported (per tray):

a. 12, 24 or 48 fibers

5. Construction:

a. Tray: Injected molded or metal

6. Related components to be provided (as necessary):

a. Mounting hardware kits
b. Heat shrink splice sleeve (40mm and/or 60mm lengths)

E. Enclosures

1. General:

a. Use: Enclosure for consolidating connectors and/or splicing of high-density optical fiber typically at communication distribution and equipment rooms.
b. Modular configuration to support connector modules, cassettes, or adapter panels for fiber terminations.
c. Mounting Configurations:

1) 19-inch EIA Rack. Brackets to expand to 23-inch EIA or ETSI frame.

d. Access:

1) Sliding drawer face and tray
2) Hinged Front Door with labeling card.
3) Hinged Rear Doors.
4) Removable top covers.

e. Density: High density and capable of supporting terminations and splice trays.
f. Connector Panels: Snap in type to accommodate specified connector types as required.
g. Cable Managers:

1) Internal strand managers for service loops and strand management in back side.
2) Internal patch cord manager at front side.
3) Cable access on both sides at front and back sides. Access points should have integrated curved guards to support appropriate cable bends.

2. 4U – Rack Mount Fiber Optic Housing

a. Application: Standard rack mount fiber terminations.
b. Size: 4U (rack-units)
c. Capacity:

1) LC-Connectors: 384-strands

3. 2U – Rack Mount Fiber Optic Housing

a. Application: Standard rack mount fiber terminations.
b. Size: 2U (rack-units)
c. Capacity:

1) LC-Connectors: 192-strands

4. 1U – Rack Mount Fiber Optic Housing

a. Application: Standard rack mount fiber terminations.
b. Size: 1U (rack-unit)
c. Capacity:

1) LC-Connectors: 96-strands

2.4 PATCH CORDS

A. General Requirements:

1. The patch cords shall meet the minimum requirements noted in Performance and Criteria Section for each respective cable type based on ANSI/TIA/EIA-568-C.3 equivalent cable rating.
2. Patch cords shall be provided as part of project at main cross-connects, intermediate cross-connects, and horizontal cross-connects (as applicable), unless noted otherwise.
3. All fiber optic patch cords shall be from the same manufacturer as the fiber optic backbone and shall meet all performance requirements established in earlier sections of this specification.

4. Lengths and Colors: Refer to Technology Drawings (symbol legend) for additional requirements on various patch cord lengths and/or colors.

B. Patch Cord and Termination Types:

1. When provided by Contractor, patch cords to be provided for all fiber and connector types included in project, per sections 2.1, 2.2, and 2.3 of this specification section.
2. Refer to Technology Drawings (symbol legend) for additional requirements on various patch cord types, lengths and/or colors.

2.5 MISCELLANEOUS COMPONENTS

A. Grounding Components:

1. All fiber optic cabling with metallic sheath (i.e., Interlocking Armored Fiber) shall be grounded at each end, if cable exits the room.
2. Provide armored fiber jacket grounding straps grounded to telecom grounding busbar or ladder rack (not equipment rack), per manufacturer recommendations.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION

A. Refer to Section 27 05 00 for requirements that shall be fulfilled as part of this specification section.

B. Grounding:

1. All fiber optic cabling with metallic sheath (i.e., Interlocking Armored Fiber) shall be grounded at each end per manufacturer recommendations, if cable exits the room.
2. Refer to Telecommunications Grounding and Bonding specification section 27 05 26 for additional requirements.

C. Labeling:

1. The final labeling scheme shall be coordinated with Owner, Architect, and Engineer prior to finalizing and initiating any work. A sample scheme shall be submitted for approval.
2. Each cable, termination panel, and termination shall be identified at the Main Cross-connect (MC), at the Intermediate Cross-connect (IC), and at each station termination.
3. Refer to Specification Section 27 05 00 for additional requirements that shall be fulfilled as part of this specification section.

D. Fiber Optic Testing/Certification (Passive)-EIA/TIA-526-14

1. Multi-mode Fiber:

a. All fiber optics will be tested for end-to-end attenuation at 850nm and 1300nm; using an optical power source and an optical power meter.
b. Tests will be performed after connectors have been installed, and will be from jumper side of hub(s) bulkhead connector to the jumper side of the bulkhead connectors at the MC/IC fiber interconnect panel.

c. Maximum loss will not exceed manufacturers' passive cable system attenuation; adjusted for cable length connector loss.
d. Maximum connector pair loss is .5dB. Splices are not acceptable in this system.
e. Test results, including OTDR printouts, will be included in the final documentation package.
f. Contractor shall complete a fiber optic post installation report at the time of testing containing meter readings at both 850 nm and 1300 nm from both directions on each fiber. Report shall include actual loss and other pertinent data regarding the cables tested, including model and serial number of test equipment, cable part number, installed fiber length, building span loss at 850 nm and 1300 nm and date tested.
g. Span loss calculations are required on the final test sheet for loss at 850 nm and 1300 nm for multimode.

(D x L) + (C x # connectors)
D = Length; L = Loss; C = Connector loss (Max 0.75 dB)
1 ft. = 0.0003048 km.

2. Single-mode Fiber:

a. All fiber Optics will be tested for end-to-end attenuation at both 1310nm and 1550nm; using an optical power source and an optical power meter.
b. Tests will be performed after connectors have been installed, and will be from jumper side of the hub(s) bulkhead connector to the jumper side of the bulkhead connectors at the MC/IC fiber interconnect panel.
c. Maximum loss will not exceed manufacturer's passive cable system attenuation; adjusted for cable length and connector loss.
d. Maximum connector pair loss is 0.5 dB. Splices are not acceptable in this system.
e. Test results including OTDR printouts will be included in the final documentation package.
f. Contractor shall complete a fiber optic post installation report at the time of testing containing meter readings at both 1310nm and 1550nm from both directions on each fiber. Report shall include actual loss and other pertinent data regarding the cables tested, including model and serial number of test equipment, cable part number, installed fiber length, building span loss at 1310nm and 1550nm and date tested.
g. Span loss calculations are required on the final test sheet for loss at 1310nm and 1550nm for single-mode.

(D x L) + (C x # connectors)
D = Length; L = Loss; C = Connector loss (Max 0.75 dB)
1 ft. = 0.0003048 km.

END OF SECTION

APPENDIX 1 - EQUIPMENT SCHEDULE

General Notes:

1. This specification is intended to be performance based, with the expectation that an “end-to-end” solution is provided by one of the “pre-approved” manufacturers (or partnerships) listed below.
2. Products listed below are intended to establish “benchmark” products from one or more of the “pre-approved manufacturers”. The listed benchmark products shall be used as a baseline when submitting products from a pre-approved manufacturer that does not have specific products listed.
3. Pre-approved fiber/connectivity manufacturers (listed in alphabetical order) include:
   a. Corning
   b. Legrand / Ortronics
   c. Superior Essex / Ortronics

Table 1 - Fiber Optic Cable / Connectivity Products			
Item	**Part Name/Description**	**Manufacturer**	**Part Number**
1	OM4 Multi-mode (OFCR) Riser Rated Premises Cable (Armored) - 12-Strand		
		Superior Essex	L3012P401
2	OS2 (G657.A1) Single-mode (OFCR) Riser Rated Premises Cable (Armored) - 4-Strand		
		Superior Essex	L3004K401
3	OS2 (G657.A1) Single-mode (OFCR) Riser Rated Premises Cable (Armored) - 6-Strand		
		Superior Essex	L3006K401
4	OS2 (G657.A1) Single-mode (OFCR) Riser Rated Premises Cable (Armored) - 8-Strand		
		Superior Essex	L3008K401
5	OS2 (G657.A1) Single-mode (OFCR) Riser Rated Premises Cable (Armored) - 12-Strand		
		Superior Essex	L3012K401
6	OS2 (G657.A1) Single-mode (OFCR) Riser Rated Premises Cable (Armored) - 24 Strand		
		Superior Essex	L3024K401
7	12A Grounding Clamp (for Armored Fiber)		
		CommScope	GAK-FEC001
		Berk-Tek / Leviton	11140671

Table 2 - Fiber Optic Connectivity Products			
Item	**Part Name/Description**	**Manufacturer**	**Part Number**
1	Termination Shelf / Enclosure (4U)		
		Legrand	INFC04U-M4
2	Termination Shelf / Enclosure (2U)		
		Legrand	INFC02U-M4
3	Termination Shelf / Enclosure (1U)		
		Legrand	INFC01U-M4
4	OM4 Multi-mode Splice Cassette (LC-type) Pre-terminated with pigtails		
		Legrand	M4LCD12-50ES2A1
5	OS2 Single-mode Splice Cassette (LC-type) Pre-terminated with pigtails		
		Legrand	M4LCD12-09R1A1
6	ST Connector OS2 Single-mode		
		Corning	95-201-52-SP

APPENDIX 2 - SPECIFICATION COMPLIANCE MATRIX TEMPLATE

Indicate compliance of the proposed equipment and/or services by the word "Comply" following each paragraph number. Indicate an exception to the requirement by the word "Exception" following the applicable paragraph number. Should the proposed equipment and/or services not entirely comply with the requirements specified, but ultimately achieve the intent, the Bidder shall explain fully the extent, or lack thereof, of compliance for the applicable equipment and/or services proposed. Instances where there is no indication of compliance or exception shall be considered non-compliant.

Contractor shall submit Compliance Matrix with the Bid Proposal AND at the time of Product Data submittal (as indicated previously in this specification) so that a complete system submittal reviewed can be performed. Contractor shall use the following template to create a full Compliance Matrix for each specification section including Parts 1, 2, and 3.

	COMPLIANCE	**EXPLANATION**
PART 1		
1.1		
A	COMPLY	
B	EXCEPTION	Note clarifications and/or reason for exception here.
C	COMPLY	
1.2		
A.1	COMPLY	
A.2	COMPLY	
B	COMPLY	
C.1	COMPLY	
C.2	COMPLY	
D.1a	COMPLY	
D.1b	COMPLY	
D.2a	COMPLY	
xx	COMPLY	
xx	COMPLY	

This page is intentionally left blank.

SECTION 27 15 00 - COMMUNICATIONS HORIZONTAL CABLING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Product Appendix: Refer to Appendix 1, Equipment Schedules, at the end of this section, for specific product information on the benchmark products. These equipment schedules should be the baseline for product data submittals but are not intended to be an all-encompassing bill of materials, unless noted otherwise.

B. Refer to Section 27 05 00 (Part 1 and Part 3) for requirements that shall be fulfilled as part of this specification section.

C. General provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections.

D. Architectural, Electrical, and Technology Drawings. Other systems drawings may apply.

E. Division 26 Specifications. Coordinate Electrical System requirements. Basic Electrical Materials and Methods sections apply to work of this section.

F. Division 27 Specifications. Provide requirements in all corresponding Division 27 Specifications.

G. Rough carpentry is specified in a Division 6 section.

PART 2 - SYSTEM REQUIREMENTS

2.1 HORIZONTAL STRUCTURED CABLING SYSTEM

A. Topology

1. The Communications Horizontal Cabling will be an industry standard physical star topology with cabling routed to each communication device outlet location from the nearest Horizontal Cross-connect (HC) location, unless noted otherwise.
2. Communications horizontal cabling shall not exceed a total cable length of 295-feet (90m) for the permanent basic link. The channel length shall not exceed 325-feet (100m) when patch cords are installed.
3. Contractor(s) responsible for providing the communications horizontal raceway and/or cabling shall ensure that the pathway and cable to each device location does not exceed 295-feet (90m) length back to the nearest HC location. Contractor shall bring any distance concerns to the attention of the Architect and Engineer during the bid process and/or at a minimum during the shop drawing process, prior to installation.
4. Contractor shall immediately notify Owner, Architect, and Engineer of any cable segment that exceeds the length limitation.
5. Refer to drawings for additional requirements.

B. General Requirements

1. All cable and terminations shall meet the minimum Performance and Criteria listed in specification below and on drawings.
2. Cable requirements including cable quantities are specified on the drawings.
3. All cables shall have the appropriate fire spread rating per building codes, industry standard, and Underwriters Laboratory (UL/cUL) including plenum (CMP/OFNP/OFCP), riser (CMR/OFNR/OFCR), etc. The contractor shall verify the appropriate cable is being used for application it is installed.
4. Any cable routed outside and/or below grade shall utilize specific water block construction. Cables generally use gel-filled compound to achieve this rating for copper cable and dry water block paper for others. The contractor is required to submit an Outdoor Rated and/or Underground Rated solution wherever this condition exists regardless of whether noted on drawings.
5. Outdoor Rated and/or Underground Rated cable that doesn't carry a suitable building cable rating per building code and UL, shall not be routed more than 50-ft (15m) inside the building. Cable shall be spliced or terminated as appropriate and noted on drawings.
6. Cabling system shall be procured from a single manufacturer that offers a complete end-to-end certified and warranted system for the TIA-568-C.2 Category noted for each system. Additionally, all products provided shall be the newest products offered by the manufacturer for the product category specified.
7. Cable splices of any kind are not acceptable for communications horizontal cabling system.
8. Cables from different low voltage systems (ex. 70v Speaker, BMS, etc.) shall not be run in the same conduit pathways unless specifically noted on the drawings.

C. Performance and Criteria

1. General Horizontal Cabling Requirements:

   a. Cable Rating:

      1) Riser Rated (CMR) or General Communications Rated (CM) when installed in non-plenum spaces as determined by Authority Having Jurisdictions (AHJ).
      2) Indoor/Outdoor Rated (all outdoor or below grade applications originating within the building).

   b. Cable Construction:

      1) Type: Unshielded Twisted Pair.
      2) Medium: Solid Annealed Copper.

   c. Length Limitations:

      1) 295-feet (90m).

   d. Physical Specification

      1) Standard Cable Sizes: 4-pairs.
      2) Conductor Size: 24 AWG.

   e. Compliances:

      1) TIA-568-C.2,

2) NEC/CEC Type CMP.

f. Electrical Specification

1) Characteristic Impedance: 100 Ohms.
2) Cat.6 Frequency: 1-250 MHz.
3) Cat.6A Frequency: 1-500 MHz.

g. Temperature:

1) CMP Operating and storage: -4 to +140ºF (-10 to +60ºC)

h. Pulling Tensions (max): 25-lb (11 kg).
i. Channel Performance: in conformance with current edition of TIA-568 for Cables, Connecting Hardware, and Patch Cables

1) Alternate Only: Category 6
2) Base: Category 6A

2.2 CABLE REQUIREMENTS

A. General

1. The cables shall meet the minimum requirements noted in Performance and Criteria Section for each respective cable type based on TIA-568-C.2 equivalent cable rating.
2. Colors:

a. Device outlets, patch panel termination labels, and patch cords may be colored to differentiate application types. Horizontal voice/data cables do not require separate colors. Refer to Technology drawings (symbol legend) for additional requirements on color coding.

B. Category 6 Riser Rated – Horizontal Cable – Alternate Only

1. General:

a. This cable shall meet the minimum requirements noted in Performance and Criteria Section for Category 6.

2. Application: Primarily for communications horizontal cable installation within duct, conduits or cable trays.
3. Construction:

a. Insulation: Flame retardant semi-rigid Fluoropolymer.
b. Shield/Sheath: None.
c. Filling Compound: None.
d. Jacket: Flame retardant PVC.

C. Category 6A Riser Rated – Horizontal Cable - Base

1. General:

a. This cable shall meet the minimum requirements noted in Performance and Criteria Section for Category 6A.

2. Application: Primarily for communications horizontal cable installation within duct, conduits or cable trays.
3. Construction:

    a. Insulation: Flame retardant semi-rigid Fluoropolymer.
    b. Shield/Sheath: None.
    c. Filling Compound: None.
    d. Jacket: Flame retardant PVC.

2.3 TERMINATION REQUIREMENTS

A. General

1. All terminations shall meet the minimum requirements noted in Performance and Criteria Section for each respective cable type based on TIA-568-C.2 equivalent cable rating.
2. All terminations for copper cables located on the face of the building or at remote locations outside of the building footprint (i.e., IP security cameras, WLAN data, etc.) shall have surge protectors at the termination point within the communications room. Contractor shall comply with manufacturer recommendations.
3. Specific and dedicated patch panels shall be used when multiple TIA-568-C.2 cable categories are used on the same project.
4. Provide all necessary wiring terminals and horizontal cable managers.
5. Provide double-sided horizontal cable manager above and below each patch panels as indicated in 27 11 00.
6. Terminate 4-pairs per RJ45 jack per T568B standard termination. Exact requirements shall be coordinated and approved with Owner, Architect, and Engineer prior to initiating any work.
7. Specific communication device outlet types shall be grouped together on patch panels. Additionally, 20% spare jacks shall be added within each grouping.

B. Modular Patch Panels (for use with RJ-45 outlets)

1. Type: Flat with Ports for Standard Modular Inserts.
2. Mounting Configuration: 19-inch Rack – Flush Mount.
3. Size: 24-port (1U) and 48-port (2U) - Provide as required to terminate all cable.
4. Built-in Strain Relief Bar
5. Colors:

    a. Patch panel outlets may require color coding to differentiate application types. Refer to Technology drawings (symbol legend) for additional requirements on color coding.

C. RJ45-Type Device Outlet Jacks

1. Transmission Performance to Match Cabling (TIA Cat 6 or 6A)
2. Type: RJ45-Type
3. Pin Configuration: T568B.
4. Mounting Configuration: Faceplates, Trim Plates, and Modular Patch Panels.
5. Colors:

    a. Jacks and/or termination labels may require color coding to differentiate application types. Refer to Technology drawings (symbol legend) for additional requirements on color coding.

6. Cable Interface:

    a. Input: 110-Type (back).
    b. Output: RJ45-Type (front).

7. Electrical Specifications:

    a. TIA-568-C.2:
    b. Insulation Resistance: 500 MegaOhms (minimum).
    c. Current Rating: 1.5A @68ºF (20ºC).
    d. Dielectric Withstand Voltage: 1000 VAC RMS, 60Hz (minimum), contact-to-contact and 1,500 VAC RMS, 60Hz (minimum) to exposed conductive surface.
    e. UL and cUL Listed
    f. FCC Part 68.

8. Plug Requirements:

    a. Retention Force: 30-lb (133N).
    b. Insertion Life: 750 minimum.
    c. Plug/Jack Contact Force: 0.22-lb (100g).

9. Temperature

    a. Operating: +14 to +140ºF (-10 to +60ºC).
    b. Storage: -40 to +158ºF (-40 to +70ºC).

D. Field Terminated RJ45 Plugs

1. Transmission Performance to Match Cabling (TIA Cat 6 or 6A)
2. Type: RJ45-Type
3. Pin Configuration: T568B.
4. Mounting Configuration: Field Terminate to plug directly into devices such as ONT, wireless access points, security cameras, etc.
5. Cable Interface:

    a. Input: 110-Type (back).
    b. Output: RJ45-Type (front).

6. Electrical Specifications:

    a. TIA-568-C.2:
    b. Insulation Resistance: 500 MegaOhms (minimum).
    c. Current Rating: 1.5A @68ºF (20ºC).
    d. Dielectric Withstand Voltage: 1000 VAC RMS, 60Hz (minimum), contact-to-contact and 1,500 VAC RMS, 60Hz (minimum) to exposed conductive surface.
    e. UL and cUL Listed
    f. FCC Part 68.

7. Plug Requirements:

    a. Retention Force: 30-lb (133N).
    b. Insertion Life: 750 minimum.
    c. Plug/Jack Contact Force: 0.22-lb (100g).

8. Temperature

    a. Operating: +14 to +140ºF (-10 to +60ºC).

9. Storage: -40 to +158ºF (-40 to +70ºC).

E. Ethernet Surge Protector

1. Type: Category 6A for data speeds up to 10GbE without signal degradation.
2. Multi-stage, hybrid design SAD and GDT for protection.
3. Mounting Configuration: Standalone, DIN Rail Mount, or Rack Mount.
4. Cable Interface: RJ45 input and output.
5. UL497B Listed.
6. IEEE PoE Standard Compliance: 802.3af, 802.3at, 802.3bt Type 3 and Type 4.
7. Electrical Specifications:

    a. Service voltage: <60V.
    b. Protection Modes: Common (All), Differential (All).
    c. Clamping Voltage Common Mode: 75 Volts.
    d. Clamping Voltage Differential Mode: 72 Volts.
    e. Power Handling: Up to 144 Watts.

F. Faceplates:

1. General:

    a. Faceplates and/or trim plates shall be provided at each communication device location as necessary to install jacks.
    b. No communication device cable and outlet jack shall be installed without a faceplate to tightly secure assembly.
    c. All unused ports shall have a blank dust cover installed. The color of each dust cover shall match the faceplate color as closely as possible, unless otherwise indicated.
    d. Faceplate and/or surface box shall be provided at modular furniture locations. Coordinate requirements with Owner, Architect, and Engineer prior to purchasing components and initiating installation.
    e. Wall telephone locations shall use a modular faceplate with standard integrated mounting knobs for installing telephone handset to wall.
    f. Coordinate faceplate requirements at specialty locations for floor boxes, surface raceway, surface mount boxes, and other locations accordingly.

2. Material: (Refer to Technology Drawing details for additional information.)

    a. Wall Devices: Plastic or Stainless Steel (where specifically required).

        1) Coordinate final color and material selection of wall faceplates with Architect and Owner prior to purchase to ensure color and materials match other wall mounted device plates.

    b. Wall Phones: Stainless Steel with Mounting Lugs.
    c. Floor Box Devices: Plastic (within Floor Box cover)
    d. Modular Furniture Devices: Plastic

3. Type: RJ45 Standard Form Factor.

G. Style-Line Modular Faceplate Mounting Frames

1. Modular faceplate mounting frames shall be provided as necessary to support RJ-45 outlet jacks within all Floor Boxes and/or Surface Raceway.
2. Coordinate final color selection of mounting frames with Owner, Architect, and/or Engineer prior to purchase to ensure color matches floor box or surface raceway material finish. As a minimum, the color black shall be submitted for approval.

H. 106-Style Modular Faceplate Mounting Frames

1. Modular faceplate mounting frames shall be provided as necessary to support RJ-45 outlet jacks within all wall mounted TV outlets with combination power and data. Additionally, Contractor may elect to use this faceplate type for surface raceway devices.
2. Coordinate final color selection of mounting frames with Owner, Architect, and/or Engineer prior to purchase to ensure color matches floor box or surface raceway material finish. As a minimum, the color black shall be submitted for approval.

2.4 PATCH CORD REQUIREMENTS

A. General:

1. The patch cords shall meet the minimum requirements noted in Performance and Criteria Section for Category cable as applicable based on TIA-568-C.2 equivalent cable rating.
2. Patch cords shall be provided as part of project at main cross-connects, intermediate cross-connects, horizontal cross-connects, and communication device outlet locations.
3. Exact patch cords requirements including TIA-568-C.2 category, quantity, and lengths shall be coordinated with Owner, Architect, and Engineer.
4. The sum of patch cord lengths when added the permanent basic link shall not exceed 325-feet (100m).
5. Construction: Unshielded Twisted Pair type.
6. Electrical Specifications:

    a. TIA-568-C.2:
    b. UL and cUL Listed CM Cordage
    c. FCC Part 68.

7. Plug Requirements:

    a. Retention Force: 30-lb (133N).
    b. Insertion Life: 750 minimum.
    c. Plug/Jack Contact Force: 0.22-lb (100g).

8. Temperature

    a. Operating: 14 to +140ºF (-10 to +60ºC).
    b. Storage: -4 to +140ºF (-20 to +60ºC).

9. Lengths: Refer to Technology drawings (symbol legend) for additional requirements on various patch cord lengths.
10. Colors:

    a. Patch cords shall be colored to differentiate application types. Refer to Technology drawings (symbol legend) for additional requirements on color coding and quantities.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION

A. Refer to Section 27 05 00 for requirements that shall be fulfilled as part of this specification section.

B. Elevator Interface

1. Provide for Elevator Junction Box requirements, as follows:

a. Low Voltage Cabling Contractor shall provide an elevator device junction box located within or outside of the Elevator Machine Room, for interface of elevator devices (elevator phones, IP security cameras, etc.) to be located within the elevator cab(s). This requirement complies with ANSI A17.1 code which prevents work within the Elevator Machine Room, other than specific elevator work.
b. Elevator device J-box shall include a keyed lockable door. Additionally, J-box shall have proper terminal strips suitable for terminating all cables within the J-box.
c. Coordinate exact location of elevator device junction box with the Elevator Contractor, Architect, and Engineer, prior to installation.
d. Provide all cabling as required between the elevator device J-box and the IC-room for all elevator device interfaces.
e. Provide all required interface points for connecting to elevator relays and travel cables.
f. The Elevator Contractor shall provide all cables in conduit from the elevator machine room to the associated elevator device J-box.
g. Cables entering the elevator device J-box shall be appropriately labeled by the Elevator Contractor, so that the Low Voltage Cabling Contractor can connect to the appropriate wires. Wires should be individually labeled to separate them from other elevator functions and to assist the Low Voltage Cabling Contractor in making proper connection points.

C. Labeling:

1. The labeling scheme shall be provided by the Contractor and coordinated with Owner, Architect, and Engineer prior to finalizing and initiating any work. A sample scheme shall be submitted for approval.
2. Each cable, wiring block, patch panel, and termination shall be identified at the main cross-connect (MC), at the intermediate cross-connect (IC), and at each station termination.
3. Refer to Specification Section 27 05 00 for additional requirements that shall be fulfilled as part of this specification section.

D. Horizontal Systems Cable Testing:

1. All communications copper horizontal cabling and pairs shall be tested for electrical continuity and wire map.
2. Cable testing shall confirm to the cables TIA-568-C.2 rating.
3. All cabling will be test/certified for conformance to the TIA-568-C.2 Category 6 and Category 6A specifications using TSB-67 Level 4 time domain reflectometer (TDR) or approved equivalent test equipment.
4. Cable tests will be per industry standard and also include the following:

a. Cable Length

b. Attenuation
c. NEXT
d. Characteristic Impedance
e. Mutual Capacitance
f. Resistance
g. Noise
h. Wire Map

5. (5) Printed test results shall be submitted on disc and printed copies by the Contractor for approval by Owner, Architect, and Engineer.

END OF SECTION

APPENDIX 1 - EQUIPMENT SCHEDULE

General Notes:
1. This specification is intended to be performance based, with the expectation that an “end-to-end” solution is provided by one of the “pre-approved” manufacturers (or partnerships) listed below.
2. Products listed below are intended to establish “benchmark” products from one or more of the “pre-approved manufacturers”. The listed benchmark products shall be used as a baseline when submitting products from a pre-approved manufacturer that does not have specific products listed.
3. Pre-approved manufacturers (listed in alphabetical order) include:
   a. Superior Essex / Legrand / Ortronics

Table 1 - Horizontal Cable / Information Outlet Jacks - 6A			
Item	**Part Name/Description**	**Manufacturer**	**Part Number**
1	Category 6A Riser Rated Cable		
		Superior Essex	6B-###-XA
2	Category 6A Indoor/Outdoor Cable		
		Superior Essex	6B-272-ER
3	Category 6A Information Outlet Jack (XX = Color)		
		Legrand	HDJ6A-XX
4	Category 6A Field Term Plug		
		Legrand / Ortronics	FTPUC6A

Table 2 - Connectivity Products			
Item	**Part Name/Description**	**Manufacturer**	**Part Number**
1	24-port Patch Panel - Flat Modular (Individual Jack Inserts)		
		Legrand / Ortronics	PHDHJU24
2	48-port Patch Panel - Flat Modular Flat (Individual Jack Inserts)		
		Legrand / Ortronics	PHDHJU48
3	Surface Mount Box "Biscuit" (# = Number of Ports, XX = Color)		
		Legrand / Ortronics	404HDJ#-XX
4	Blank Outlet Dust Covers (XX = Color)		
		Legrand	HDJBL10-XX
5	Stainless Steel Faceplate - Wall Phone with Lugs		

		Legrand / Ortronics	403STJ1WP plus HDJTJA20
6	Stainless Steel Faceplates (with label window) (# = Number of Ports)		
		Legrand / Ortronics	403STJ1# plus HDJTJA20
7	Plastic Faceplate (with label window) (# = Number of Ports, XX = Color)		
		Legrand / Ortronics	403HDJ1#-XX
8	Modular Furniture Faceplate, 4-port (Black)		
		Legrand / Ortronics	421HDJ4-00
9	Style-Line Outlet Frames (Multi-port, XX = Color)		
		Legrand / Ortronics	41900017-XX
10	106-Style Outlet Frames (Multi-port, Black)		
		Legrand / Ortronics	40800017 (2-Port) 40800019 (4-Port)
11	Category 6A Ethernet Surge Protector - PoE		
		Ditek	DTK-110C6APOE
		Ditek	DTK-MRJPOE DTK-RM12POE

APPENDIX 2 - SPECIFICATION COMPLIANCE MATRIX TEMPLATE

Indicate compliance of the proposed equipment and/or services by the word "Comply" following each paragraph number. Indicate an exception to the requirement by the word "Exception" following the applicable paragraph number. Should the proposed equipment and/or services not entirely comply with the requirements specified, but ultimately achieve the intent, the Bidder shall explain fully the extent, or lack thereof, of compliance for the applicable equipment and/or services proposed. Instances where there is no indication of compliance or exception shall be considered non-compliant.

Contractor shall submit Compliance Matrix with the Bid Proposal AND at the time of Product Data submittal (as indicated previously in this specification) so that a complete system submittal reviewed can be performed. Contractor shall use the following template to create a full Compliance Matrix for each specification section including Parts 1, 2, and 3.

	COMPLIANCE	**EXPLANATION**
PART 1		
1.1		
A	COMPLY	
B	EXCEPTION	Note clarifications and/or reason for exception here.
C	COMPLY	
1.2		
A.1	COMPLY	
A.2	COMPLY	
B	COMPLY	
C.1	COMPLY	
C.2	COMPLY	
D.1a	COMPLY	
D.1b	COMPLY	
D.2a	COMPLY	
xx	COMPLY	
xx	COMPLY	

SECTION 27 41 00 - AUDIO VISUAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. This section is valid only when considered in total with complete Construction Document package. References are for the convenience of the reader and their inclusion in or omission from any section in no way limits its scope or intent of any Contract Documents.

B. Drawings and general provisions of the Contract, including General Conditions, Supplementary Conditions, and Division 01 - Specification Sections, apply to the provisions of this section.

C. Division 26 Basic Materials and Methods sections apply to work in this section.

D. Division 27 in its entirety.

1.2 SUMMARY

A. Coordinate project schedule, installation schedule, phasing and any other requirements deemed necessary with Construction Manager and/or General Contractor and all necessary trades to ensure successful completion of work.

B. The extent of Audio Visual infrastructure work is indicated by Division 27 specifications and Technology drawings and schedules and is hereby defined to include, but not by way of limitation, the provisions of:

1. Raceway systems including but not limited to conduits, cable trays, sleeves, surface raceways, telecommunication services entrance, manholes, pull-boxes, junction boxes, back-boxes, as required and specified in Division 26 sections. The Construction Manager and/or General Contractor shall coordinate this with the Sub-Contractors performing work and determine how scope of work is assigned. The purpose of this specification is to establish design intent and general system scope.
2. All audio visual system’s infrastructure shall be provided as part of the Base Building Project including but not limited to raceway, conduit, floor and back-boxes, pull and plenum job boxes, poke-through, structural support elements, and mounting frames.
3. Patch cords, jumper cables, and cross-connect cables to interconnect wiring terminals as well as electronic equipment. These cords shall be rate equivalent of better than the point to point cabling.
4. AV rack/cabinet fit-out including cabinets, racks, fans, power management hardware, backboard, and raceways for terminating cable and installation of electronic equipment.
5. Power distribution within equipment racks and cabinets including power sequencers, power supplies and power strips.
6. Grounding and bonding of all metallic hardware components to the nearest telecommunications grounding bus (TGB) bar including but not limited to equipment racks, cabinets, cable trays, ladder rack, metallic cable sheaths, wall mounted wiring terminals, conduits, sleeves, metallic ductwork, and frames when AV equipment is co-located in a Telecom Room or Communication system equipment closet.
7. All physical cable management hardware including, but not limited to: “J-hooks” in accessible ceiling areas, “D-rings” on backboards, vertical and horizontal managers on racks and cabinets.

8. Fire stopping as required. Contractor shall provide fire stopping for all low-voltage openings (including empty low voltage raceway) once cable installation is complete. Confirm specific fire stopping scope requirements with General Contractor and/or Construction Manager.
9. Design and fabrication for custom loudspeaker mounting and rigging assemblies to be reviewed and approved by Structural Engineer and local governing jurisdiction.
10. Seismic bracing of all equipment cabinets, equipment racks and ladder-type or wire basket cable tray, ceiling mounted loudspeakers as required by code and by local governing jurisdiction.
11. Verifiable testing of all AV cable infrastructure and grounding systems as noted by specification, drawings, and applicable industry standards.
12. Labeling of all AV infrastructure components, hardware, cable, and terminations with mechanically printed labels.
13. Preparation and submission of product data, shop drawings, testing reports, as-built drawings, Operations and Maintenance manuals, quick operation guides and cabling documentation as required in this specification.
14. Software, including executable files for all electronic devices requiring custom programming as part of a turn-key solution.
15. Construction and Installation warranties.
16. Installation and testing of all system and components.
17. Onsite administrative and user training.

1.3 INFORMATION SUBMITTALS

A. This subsection pertains to all AV Contracting firms providing they can meet or exceed the general requirements listed below. The General Contractor and or the Electrical Contractor shall not have the sole right to determine the eligibility of AV Integrators/Contractors. This is an act reserved for the Owner and the Engineer, but can coordinate and submit their preferences and or reservations with the design team and Engineer. Each bidding firm must comply and submit all of the requested documentation found within this subsection below:

B. Company Profile:

1. The Contractor shall be a firm with at least ten (10) years' experience in the fabrication, assembly, and installation of audio visual systems of similar magnitude. The Contractor shall submit this documentation to the Architect, Owner's Representative and the AV Engineer one (1) week prior to the bid return date. No exceptions will be made for late or incomplete documentation as this documentation will be rejected.
2. Documentation shall include a breakdown of the total number of employees, clearly indicating area of responsibility and length of time with firm in that capacity. Employee profile will include number and level of ICIA (InfoComm) CTS/Installers and NSCA NICET certified installers, if any, available for the project installation. The Bidder shall also indicate union status, if any, of shop and field installation personnel.

C. Project Team:

1. The Contractor shall clearly identify project team members and that statement shall include name, years with firm and a brief resume of the employees past projects and education. Pertinent team members that are to be identified shall be Project Manager, Chief Engineer, Programmer, Senior Field Technician, and Senior Bench Technician.

    a. Engineer: Shall be certified as a CTS-D or shall be a licensed Professional Engineer (PE). On projects utilizing systems from manufacturers with a recommended training, testing, and credentialing program, the engineer shall be certified to the highest relevant level offered by that manufacturer.

b. Project Manager: Shall be certified as CTS. On projects utilizing systems from manufacturers with a recommended training, testing, and credentialing program, the project manager shall be certified to the highest relevant level offered by that manufacturer.
c. Programmer Certification: Due to the complexity of the today's projects, the Contractor shall have in-house, manufacturer certified programmers on all equipment requiring programming or custom configurations. The Contractor shall provide complete proof of current certifications within their pre-qualification documentation prior to the bid submittal due date.

D. Note: Consultant reserves the right to verify certification status with each manufacturer as necessary.

E. In House Capabilities: Contractor shall have in-house capabilities and facilities for equipment rack assembly, shop fabrication, software programming and equipment testing. All equipment racks shall be assembled and thoroughly tested at the Contractor facility prior to delivery and installation at the project site. The Contractor shall provide a signed statement with the other pre-qualification documentation.

F. Similar Projects:

1. Documentation must identify, specifically, similar projects of the same or greater magnitude. Of those projects noted, the Contractor must provide current owner/user contact names and telephone numbers, as well as a job description and total value of the audio, video and control components, with a clear delineation between labor and equipment costs, as well as duration of project. The submittal supplied must clearly state that the firm submitting the bid response has actively been involved in the projects in a site installation and service capacity.

G. Submittal Schedule:

1. In addition to the requirements noted herein, refer to Division 1 Specification for additional requirements. As a minimum, Contractor shall ensure all requirements listed here are met.
2. Within two weeks after award of contract, the Contractor shall submit a proposed schedule for submitting product data and shop drawings. At a minimum, the following items shall be included:

a. Submittal date for Compliance Matrix.
b. Submittal date for Construction Schedule.
c. Submittal date for Product Data and Shop Drawings.
d. Submittal date for Commissioning and/or Test Results.
e. Submittal date for As-Builts.

3. Within 45 days after award of contract or as dictated by the construction schedule (whichever period of time is shorter), the Contractor shall submit prefabrication submittals consisting of product data and shop drawings for approval. Partial submittals will not be accepted without prior written approval from the Architect.
4. Review of the Prefabrication Submittals by the Architect is for purposes of tracking the work and contract administration and does not relieve the Contractor of responsibility for any deviation from the Contract Documents, or from providing equipment and/or services required by the Contract Documents which were omitted from the prefabrication submittals.

5. No portion of the project shall commence nor shall any equipment be procured until the prefabrication submittals (including product data and shop drawings) have been approved in writing by the Architect. All installations shall be in accordance with the Contract Documents.
6. A detailed completion schedule shall be submitted with the prefabrication submittals.
7. Prefabrication submittals shall be accompanied by a letter of transmittal identifying the name of the project, Contractor's name, date submitted for review, and a list of items transmitted.

H. Compliance Matrix:

1. Provide a specification compliance matrix indicating compliance or deviation for each item in the specification. Refer to Appendix 2 for additional requirements.

1.4 ACTION SUBMITTALS

A. Requirements of Division 01 shall apply and may supersede requirements noted herein.

B. Product Data:

1. Warranty Information: Provide all manufacturer product warranty information for review and approval.
2. Component List: Provide complete submittal component list (i.e. table of contents) at the beginning of the submittal package. Component list and manufacturer cut-sheets shall be compiled to match the order of each Appendix. Component list shall include:

    a. Component name
    b. Manufacturer
    c. Specific product number (to clearly indicate special options, colors, etc.

3. Cut-Sheets:

    a. Submit manufacturer’s cut-sheets on all components listed within this specification and corresponding appendix. All components and parts being used shall be highlighted in color on cut-sheets to distinguish specific product/part numbers, options, colors, accessories, etc.
    b. Materials and equipment supplied by the Contractor shall be new and shall meet or exceed the latest published specification of the manufacturer in all respects.
    c. The Contractor shall provide the latest comparable model, available at the time of bidding, of each piece of equipment.

4. Product Substitutions:

    a. These specifications are intended to be performance based, thus all products listed in each respective Appendix 1: Equipment Schedules are “benchmark” products.
    b. The Contractor shall include products from one of the “pre-approved” manufacturers as noted in the Appendix.
    c. All substitutions shall meet or exceed the minimum functional, physical, and technical specifications. Acceptance of such substitutions is at the discretion of the Owner, Architect, and Engineer.

C. Shop Drawings:

1. Any drawings created in a Computer-Aided Design program shall be issued in AutoCAD or Revit (latest version) format depending on which program was selected for use by the Architect as the project standard.
2. Drawings of panels, plates, designation strips and samples showing finish and color.
3. Drawings of all equipment modifications that change or void manufacturer's warranties.
4. Schematic drawings of custom circuitry shall include:

    a. Receptacle pin numbers and component callouts
    b. Details of custom resistive combining networks, filter, or pads
    c. Point-to-point wiring drawings for control system modules and interfaces, and for switches or relays

5. Provide descriptions of all control functions and all equipment states associated with each function.
6. Drawings of custom designed consoles, tables, carts, support bases, and shelves.
7. Drawings of all equipment modifications that change or void manufacturer's warranties.
8. Complete system construction and point to point wiring color schematic drawings, including all component values and showing complete letter and number identification of all wire and cable including point to point homeruns and source to input plate as well as jacks, terminals and connectors. These drawings shall detail all equipment that is to be installed or included in the project.
9. Complete system functional one-line drawings shall include:

    a. Equipment names and model numbers, and descriptions.
    b. Dimensioned equipment rack elevations outlining RU heights, equipment positions, unused rack space, total power consumption, mechanical loading, and total rack weight.
    c. Dimensioned equipment rack elevations and wall plate details, patch panel assignment drawings are required. Plate terminations for amplifier power shall show wattage and rated impedance values (in ohms); power number shown shall be 20.0% less that available wattage from amplifier for head-room unless otherwise noted on the Construction Drawings.

10. Run sheets or field wiring drawings:

    a. Show at each terminal point the type of connector to be used and include a typical wiring detail of each connector
    b. Note where shields are connected and where they will float to ensure the integrity of the grounding system
    c. Call out wire types and color-codes where appropriate
    d. Assign wire numbers and patch-bay locations to every wire and patch point.
    e. Show unused electronic equipment termination points, i.e. input/output ports as "Future".
    f. AC Power sequencing connectivity diagrams.
    g. Complete data sheets with all forms filled out, bulk cabling and terminations.
    h. Note: the substitution of the equipment originally specified in the Contract Documents in the shop drawing with prior consent of the engineer shall be rejected.

11. Loudspeaker rigging and mounting assemblies suspended from or mounted to structure shall be signed and sealed by a professional engineer licensed to practice in the state of the project. Include copy of design calculations with written approval.
12. Dimensioned loudspeaker mounting details including fly-ware and hardware harnesses with specific aiming angles for each device utilized in clusters or line array designs.

13. Wall plate details showing front and back of plate for verification of connector space.
14. Panels, plates, and designation strips, including details relating to terminology, engraving, finish and color.

1.5 DELEGATED DESIGN SUBMITTAL

A. Contractor shall program hardware and software necessary to operate AV system components. Such components include but are not limited to digital signal processors (DSP), low voltage control systems, touch panels, web interfaces, and remote management platforms. This software shall not be proprietary and be provided by the manufacturer of the sub-system.

B. All preset, configuration and executable (*.exe) files necessary for a system update (or re-installation) shall become the property of the Owner in perpetuity, no exceptions. Contractor shall provide final operating system and software files to the AV Engineer and Owner two (2) weeks prior to Final Acceptance Testing.

C. Contractor shall initiate and schedule a series of design meetings to investigate and deliver an approved Software User Interface/User Experience (“UI” “UX”) with Architect / Owner, AV Engineer.

1. Contractor shall provide printed or electronic samples of logical UX diagrams and UI templates to Architect / Owner for direction.

D. Control system and DSP programming files:

1. Contractor shall submit DSP programming file to the AV Engineer for review and acceptance at least two (2) weeks prior to on-site system installation begins.

E. Written Owner approval of UX and UI shall be attained prior to installation of equipment at site.

1. Contractor shall submit a final review of UX and UI layouts for Owner / AV Engineer review and comment no later than two (2) weeks prior to onsite installation.

1.6 CLOSEOUT SUBMITTALS

A. The Contractor shall provide one (1) full size color hard copy and an electronic copy each of the following:

1. “As-built" drawings for every item and sub-assembly for all of the areas covered under Part 3. Provide an electronic file version of the “As-Built” drawings for all systems in the latest version of Revit and or AutoCAD depending on the native drawing format utilized by the AV Engineer or specified by the Architect for the Construction Documents.
2. Equipment manufacturer's operation and maintenance manuals for each piece of equipment.
3. A System Quick Reference and Operation and Maintenance Manual. The Contractor shall produce this manual specifically for the systems detailed herein.

a. The Quick Reference section shall describe in non-technical terms for casual users the method of using the facilities. The document shall be a step-by-step operating procedure for each desired feature utilizing photos or screen captures.

b. The Operation section shall describe all typical procedures necessary to activate each system to provide for the functional requirements as listed under the Detailed Specifications. The reader of this manual shall be assumed to be technically competent, but unfamiliar with this particular facility.
c. The Maintenance section shall provide a recommended maintenance schedule with reference to the applicable pages in the manufacturer's maintenance manuals. Where the manufacturer provides inadequate information, the Contractor shall provide the information necessary for proper maintenance.
d. Front view of all equipment racks, showing the final commissioned settings for every variable push-button, rotary control, slider control, indicator, or other such indicator.
e. Recommended maintenance schedule with reference to the applicable pages in the manufacturers' maintenance manuals. Where the manufacturer provides inadequate information, provide the necessary information for proper maintenance.
f. List of replacement parts necessary and recommended for normal maintenance.

B. Notify the Owner and Architect when testing and adjustment of the systems are complete, normal settings marked, and systems are available for acceptance tests.

C. Provide completed copy of the testing and adjustment report organized according to the testing requirements in this section. Frequency related test results shall be submitted in both tabular and graphical formats.

D. Provide two (2) complete sets of software documentation for application programs and system software. Software documentation will include all source-code listings for software supplied by the Contractor and to the extent that the Contractor, having used its best efforts, is able to obtain source-code listings from any third-party suppliers. Contractor shall provide a hardcopy of final touch screen layouts. Submittal of software / firmware and *.exe files shall be on disc.

E. Provide two (2) copies for the Client and one (1) for the AV Engineer of the "Overall System Operation and Maintenance Manual", it shall include descriptions of the procedures necessary to maintain, operate and troubleshoot each system.

1.7 QUALITY ASSURANCE

A. Codes: Work shall be done according to applicable requirements of governing international, federal, state, county municipal and local codes, rules, and regulations.

B. Standards: Equipment, materials, installation and testing specified shall conform to manufacturer's recommended practices as well as the current edition of standards from the following institutions:

BICSI - Building Industry Consulting Service International
UL - Underwriters Laboratory
EIA – Electronics Industries Alliance
TIA – Telecommunications Industry Association
NEC – National Electrical Code, Latest Edition
NFPA 70, NEC Latest edition, Article 300-22(c) UL2043
NFPA 72, Latest Edition
NFPA 90A, Latest Edition, Section 2-3.10.1(a), Exception 2.
Underwriters Laboratories (UL): UL1480 (UUMW) UL Control #7P97 Air Handling Spaces, ANSI/UL263
NAB – National Association of Broadcasters
OSHA – Occupational Safety and Health Administration

NSCA – National Systems Contractors Association
ANSI/INFOCOMM - V202.01:2016 Display Image Size for 2D Content in Audiovisual Systems
ANSI/INFOCOMM - 1M-2009 Audio Coverage Uniformity in Enclosed Listener Areas
ANSI/INFOCOMM - 3M-2011 Projected Image System Contrast Ratio
ANSI/INFOCOMM - 10:2013 AV Systems Performance Verification
INFOCOMM – F501.01:2015 Cable Labeling for Audiovisual Systems
INFOCOMM - Audiovisual Best Practices
ISO - International Standards Organization
AES - Audio Engineering Society

1.8 DELIVERY, STORAGE, AND HANDLING

1.9 PROJECT / SITE CONDITIONS

1.10 DEFINITIONS

A. The term "Engineer" shall refer to M-E Engineers, Inc., under contract to the Architect, Fentress, and is responsible for the design and specification of the audio-visual systems.

B. The terms “AVC”, "AV Contractor" and “Contractor” shall refer to the Audio-Visual Systems Contractor who has been awarded the contract for this scope and who has responsibility for the performance of the work specified in this specification.

C. The term “provide” used throughout this specification and drawings shall mean “furnish, install, test, and certify.”

D. The term "specified elsewhere" shall refer to material and work which is related to this contract and for which the Contractor is not responsible except as otherwise detailed herein. Some or all of these items may be included in the overall electrical contract.

E. The term "NIC" refers to work or equipment that is not in the contract covered in this specification.

F. The term "shall", is mandatory; the term "will", is informative; the term "should", is advisory; and the term "provide", means furnish and install.

G. The term “Complete” shall refer to equipment and systems that shall be provided with all necessary accessories to complete a turn-key solution. Example: “equipment racks” that include doors, locks, side panels, covers, blank and vented panels, motorized fans, cable management, AC power distribution and sequencing. Another example would be control systems that must include all accessories such as RF transceivers, RS-422/485 baluns, distribution amplifiers, PoE power supplies or switches (unless otherwise noted on the one-lines), and external power strips and supplies, cable management as required providing the Owner with a fully functional and operational turn-key solution. If the Contractor is unclear about a particular piece of equipment, system accessories, or design intent, then it is the sole responsibility of the Contractor to immediately contact the Engineer via the RFI process for clarification prior to the bid submittal.

H. The term "OFCI" shall refer to Owner Furnished equipment, which shall be provided by the Owner or its designee to the Contractor for installation. The Contractor shall be responsible for installing the equipment at the project site in good functional order as detailed herein.

I. The term “EC” shall refer to the Electrical Contractor.

J. The term ‘GC” shall refer to the General Contractor.

K. The term “Bidder” shall refer to a firm submitting a bid response to this specification.

L. Refer to Section 27 05 00 for additional requirements that shall be fulfilled as part of this specification section.

1.11 SYSTEMS DESCRIPTION

A. Wellness Center:

1. Audio Video Systems

a. Flat panel displays (content via streaming only)
b. Distributed audio loudspeakers
c. Media player
d. Bluetooth connection
e. Wall mounted touch panel control for power on/off, source selection, and volume control

B. Elevator Lobbies

1. Video systems

a. Flat panel display
b. Wayfinding player

C. Atrium

1. Audio systems

a. Distributed audio loudspeakers
b. Hardwire microphone connection
c. Wireless microphones
d. Media player
e. Volume control

D. Judge’s Chamber, Judge’s Workroom:

1. Polycom Video Conferencing Systems

a. Flat panel display
b. All-in-one camera, microphone, speaker soundbar
c. Hardwire HDMI connection
d. Furniture cable management system (HDMI passthrough tabletop)
e. Wireless presentation connection
f. Wall mounted touch panel control for power on/off, source selection, and volume control (Judge’s Workroom Only)

E. Small Conference Rooms, Small Mediation Rooms:

1. Polycom Video Conferencing Systems

a. Flat panel display
b. All-in-one camera, microphone, speaker soundbar
c. Hardwire HDMI connection
d. Furniture cable management system (HDMI passthrough tabletop)
e. Wireless presentation connection

f. Tabletop touch panel control for power on/off, source selection, and volume control
g. Room Scheduler

F. Medium/Large Conference Rooms, Medium/Large Mediation Rooms:

1. Polycom Video Conferencing Systems

a. Flat panel displays
b. Distributed audio loudspeakers
c. Microphones
d. PTZ camera
e. Hardwire HDMI connection
f. Furniture cable management system (HDMI passthrough tabletop)
g. Wireless presentation connection
h. Tabletop touch panel control for power on/off, source selection, volume, lighting, and shade control
i. Room Scheduler

G. Training Rooms:

1. Divisible room functionality

a. Divisible room partition sensor

2. Audio Video Systems

a. HD Projectors
b. Projection Screens
c. Assistive Listening
d. Wireless Microphones
e. Microphone stands
f. Distributed audio loudspeakers
g. Microphones
h. Hardwire HDMI connection through floor box
i. Furniture cable management system (HDMI passthrough tabletop)
j. Wireless presentation connection
k. Tabletop touch panel control for power on/off, source selection, volume, lighting, and shade control
l. Room Scheduler

H. Courtrooms:

1. Audio Video Systems

a. Flat panel displays for general presentation of content.
b. Fixed desk microphones
c. Distributed audio loudspeakers
d. Sound masking system
e. Assistive listening
f. Wireless microphones
g. Language Interpretation and Translation
h. Polycom video conferencing w/ PTZ cameras
i. Hardwire HDMI connection
j. Furniture cable management system (passthrough tabletop)
k. Tabletop touch panel control

l. Internal broadcasting steerable cameras
m. External broadcast (press) connections in room via junction box

I. Signal Routing Table:

		At Router	Video Wall Processor	Video Room Display 1	Video Room Display 2	Video Room PC Capture 1	Video Room PC Capture 2	Press Room Display 1	Press Room Display 2	Home Team Locker VW1	Home Team Locker VW2	Home Team Locker Aux Displays	Coach Locker Room Display 1	Coach Locker Room Display 1	Training Room	Green Room
Signal Type	**Connector**	25	25	18	18	18	18	23	23	2	2	2	19	19	6	12
LOCAL DISPLAY INPUTS																
Comcast Box	HDMI (1)	X						X	X			X	X	X	X	X
Wall Plate	HDMI (1)			X	X								X	X	X	X
ROUTER OUTPUTS																
ROUTER:	SDI - HDMI	N/A	X	X	X	X	X	X	X			X	X	X	X	X
Comcast Box	HDMI - SDI	X	X													
Video Wall Processor	TBD	X	N/A							X	X					
Video Room PC1	HD-SDI	X	X													
Video Room PC2	HD-SDI	X	X													
Press Camera	HD-SDI	X	X													
3-Play	FIBER (LC)	X	X													
DVSport	FIBER (LC)	X	X													
MISC SIGNAL EXTENSION*																
USB Extension	USB- CAT5e					X	X						X	X		
** USB extension provided for Cowboy Remote. Connect to OFE PCs in Video Room.																

1.12 WARRANTY

A. Provide manufacturers standard warranty on all products as applicable.

1.13 OWNER TRAINING

A. The Contractor shall provide on the job training by the project engineer, to personnel designated by the Owner, to instruct them in the operation of the systems. In the event the Contractor does not have qualified instructors on staff for sophisticated equipment, the Contractor (at no additional cost) will provide a manufacturer's representative for such instruction to the Owner.

B. The first round of training shall take place after the systems are operational, but before the acceptance tests. There shall be a minimum of: Two (2) owner training sessions of 2 hours each with the end users and district IT person including ME Engineers AV designers. There shall also be a minimum of two (2) follow up training sessions of 2 hours each directly with the district and IT person after the systems have been in use and for any final training needs. Training to included detailed training and use of the Soundcraft mixers and use with the Dante audio and control network. Detailed training of the wayfinding players and features/functions of the digital signage functionality. This should not include content creation but will need to have a focus on how to manage and schedule content to be displayed. Detailed training of the multipurpose room control panel GUI and features including presets and also and advanced audio controls page.

C. The AV integrator should coordinate with end user and the AV designer on final GUI layout and control functions prior to submittal.

1.14 COMMISSIONING

1.15 MAINTENANCE AND SUPPORT

A. Extra Materials / surplus stock

B. Onsite Support / Event Support

C. Service agreements

PART 2 - PRODUCTS

2.1 GENERAL

A. Materials: Supply materials and equipment that shall be new and shall meet or exceed the latest published specifications of the manufacturer.

B. Supply the latest model, available at the time of bidding, of each piece of equipment. The Owner may request, at their option, that the latest model of equipment, or new technology, available at the time of installation be provided. If a later model is requested, adjustments will be made to cover cost changes between the cost at bid submittal and the cost of the latest model at the time of installation.

2.2 EQUIPMENT

A. See Appendix 1 for equipment schedules

PART 3 - EXECUTION

3.1 INSTALLATION PRACTICES

A. General

1. Audio Visual Systems Contractor (AV Contractor or Contractor) shall coordinate with Electrical Contractor (EC) on conduit/junction box locations for audio equipment and routing of audio, control, and power cables/conduits from terminals, poke-thru /floor and pull boxes, wall plates, stub-ups to system equipment racks.
2. Installation shall include the delivery, unloading, setting in place, fastening to walls, floors, ceilings, counters, or other structures where required, interconnecting wiring of the system components, equipment alignment and adjustment, and all other work whether or not expressly required herein which is necessary to result in complete operational systems.
3. Contractor shall construct AV equipment racks and sub-assemblies, including all equipment to be installed therein off-site. All wiring work, labeling of wiring, cable dressing, hardware supports, and connection panels, cable wiring documentation, socket installation, ventilation and power supply regulation and filtering component installation shall be performed in AV Contractor's own premises.

4. The Contractor shall not deliver equipment in original packaging to the site for installation. All such equipment will be unpacked and checked thoroughly in AV Contractor's premises. Contractor shall test such equipment as it is received to ensure that it conforms to the manufacturer's specifications. On no account shall the Owner be liable for any delays of completion of the installed system due to defective equipment being received by Contractor.
5. For the purposes of coordination with Architects specified furniture, the Contractor will insure that such equipment or mounting hardware is compatible with and suitable for installation in that furniture. It shall be the AV Contractor's responsibility to ensure they coordinate with the furniture and our millwork contractor and that parties shall exchange and follow their Shop Drawings to ensure that dimensions and structural supports are adequate for the AV equipment installation. It is the AV Contractor's responsibility that the request and delivery of such critical coordination information is satisfactorily executed and in as much as the Contractor has control over the delivery of such information, the Contractor shall deliver it as requested by the Architect.
6. All installation practices shall be in accordance with, but not limited to, the general design and construction requirements of the Architect, and these specifications and drawings. Installation shall be performed in accordance with the applicable standards, requirements, and recommendations of local authorities having jurisdiction (AHJ). Before commencing work, the Contractor shall familiarize all project team members with all of these requirements.
7. If, in the opinion of the Contractor, an installation practice is desired or required, which is contrary to these specifications or drawings, a written request for modification shall be made to the AV Engineer and/or Architect. Modifications shall not commence without written approval.
8. During the installation, and up to the date of issuance of the Final Acceptance Memorandum, the Contractor shall be under obligation to protect their finished and unfinished work against damage and loss. In the event of such damage or loss, they shall replace or repair such work at no cost to the Owner.

3.2 CLEAN UP AND REPAIR

A. During the installation, the Contractor shall be expected to maintain a clean and safe working environment.

B. Upon completion of the work the Contractor shall remove all their refuse and rubbish from and about the premises, and shall leave the relevant areas and equipment clean and in an operational state. The Contractor shall be responsible for repairing any damage caused to the premises by the AV Contractor's installation activities, at no cost to the Owner.

3.3 SECURITY

A. Provide a project security program to:

1. Protect Work, stored products, and construction equipment from theft and vandalism.
2. Protect Owner's operations at site from theft, vandalism or damage from Contractor's work or employees
3. Maintain security program throughout construction period, until Owner occupancy or Owner acceptance precludes the need for Contractor security.

3.4 PHYSICAL INSTALLATION

A. All equipment shall be firmly secured in place unless the equipment has been documented to be portable in nature, either within this specification or as shown in the Construction Documents.

B. All fastenings and supports shall be adequate to support their loads with a safety factor of five (5) times the load weight or as required by Code, whichever is greater. Wind shear must be taken into account when installing all pole mounted loudspeakers.

C. All boxes, equipment, wall plate, speakers cabling shall be secured plumb and square.

D. All loudspeakers shall be installed according to the manufacturers' instructions. All loudspeakers shall be installed with a secondary seismic safety harness assembly in addition to the specified loudspeaker mount.

E. In the installation of equipment and cable, consideration shall be given not only to operational efficiency, but also to overall aesthetic factors. When an issue regarding a visual aesthetic that the Contractor is aware of, they shall inform the Project Manager and Architect immediately so that all parties can coordinate and provide an adequate solution in a timely manner.

F. Trim and Escutcheon Components:

1. To insure a proper finished appearance, the Contractor shall furnish and install trim/escutcheon components at all conditions where AV components pass through the finished walls, floors, and ceilings. This would include but not be limited to video projector supports, video flat panel monitors, control panels supports which are not specifically supplied with integral flanges/trim components.
2. The visible component of any trim shall be as small as possible preferably no wider than .50". All trim components at the ceiling plane shall be finished to match the approved ACT ceiling grid system components. The Contractor shall obtain a sample from the General Contractor, including any custom color information, or standard color numbers. All trim components shall be submitted to the Architect for review and approval prior to fabrication.

3.5 CABLE INSTALLATION

A. Comply with requirements in Section 078413 "Penetration Firestopping for firestopping materials and installation for penetrations through fire-rated walls, ceilings, and assemblies.

B. All cables for this project must conform to the latest version of the NEC as well as local code and owner requirements.

C. Where existing cabling is to be abandoned, it shall be completely removed as directed in the NEC.

D. All cables, regardless of length, shall be marked with permanent wrap-around number letter cable markers at both ends. There shall be no unmarked cables at any place in the system; labels must be computer-generated for legibility. Wire labels done by hand in the field must be replaced with computer generated labels. Marking codes used on cables shall correspond to codes shown on drawings and on run sheets.

E. Internal and Inter-rack cabling shall be neatly strapped, dressed, labeled, and adequately supported without pinching cable bundle.

F. Cable management: Use only Velcro type cable straps within the head-end rack to secure and route the cable bundles; no exceptions.

G. Terminal blocks, boards, strips, or connectors, shall be furnished for all cables that interface with racks, cabinets, consoles, or equipment modules. The use of “wire nuts” to terminate or connect cabling is strictly prohibited.

H. All cables shall be grouped according to the signals being carried. In order to reduce signal intermodulation distortion, separate groups shall be formed for the following cables:

1. Power cables
2. Low voltage system cables
3. Video cables
4. Audio cables carrying signal levels less than –20.0 dBm.
5. Audio cables carrying signal levels between –20.0 and +20.0 dBm.
6. Audio cables carrying signal levels above +20.0 dBm.

I. As a general practice, all power cables, low voltage control cables and high level cables shall be run on the right side of an equipment rack as viewed from the rear. All other cables shall be run on the left side of an equipment rack, as viewed from the rear.

J. When dressing the equipment rack, cables ties shall be placed at appropriate intervals of approximately six (6) inches for vertical bundles, four (4) inches for horizontal bundles. No cable ties shall cause the cable to exceed the manufacturer’s recommended bend radius or deformed the cable.

K. All vertical cable bundles internal to AV system equipment racks shall be attached to the rack frame utilizing a cable management system.

L. All cables shall be continuous lengths without splices. All system wire, after being cut and stripped, shall have the wire strands twisted back to their original lay and be terminated by approved soldered or mechanical means. No bare wire terminations shall be allowed, unless specified specifically on the drawings. No exceptions. Heat-shrink tubing shall be used to insulate the ground or drain wire.

M. All solder connections shall be made with rosin-core solder using temperature-controlled solder stations. No cold or cracked solder joints are acceptable. Any connections, which do not appear to be clean and shiny, or which show signs of cracking, shall be re-soldered by the Contractor before Final Acceptance testing of the system.

N. Mechanical connections using insulated, crimp-type connectors shall be bonded to the connector by soldering the wire to the metal part of the connector.

O. Connections made with screw actuated pressure type terminal strips shall be made by stripping approximately .25” of insulation from the stranded conductor. Then the un-tinned wire shall be inserted into the terminal and tightened.

P. All wire bundles are to be neat and combed free of cable crossovers.

Q. No cable shall be installed with a bend radius less than that recommended by the cable manufacturer.

R. All wire markers shall face a common direction.

S. All cables shall have proper connector housing.

T. All equipment racks shall be fully dressed out and cables shall not protrude from the back of the rack.

U. All cable entry shall be through the tops of racks or through entrance holes in the base of the rack. No cable shall enter racks through front, rear or side panel openings.

V. Millwork installed or pivoting racks shall be provided with a sufficient amount of dressed cabling or harness to allow free and untethered travel of the rack from the permanent locking position to the extended “service” position.

W. All cables located in the ceiling areas, excluding corridors, are to be J-hooked and kept separate from data cables with crossovers at ninety (90) degrees. Protection, such as electrical conduit, is required if the cabling is within inaccessible areas or hard lid ceilings.

X. All digital multimedia transport (HD Based T / HDBT) cabling shall be CAT6A (or better) shielded cables and terminations. Criteria required:

1. Plenum CAT6A
2. 24.0 AWG or greater
3. Solid center conductor
4. Outer shielding
5. SF/UTP or F/UTP type
6. Terminations: shielded

Y. Unless otherwise called for in these specifications and drawings, the following cables (those that apply), or their pre-approved equals: Note: Any specific cable AWG gauge found in drawing package supersedes this document. These cable types are cited to illustrate the type and quality of cable required. Plenum cable must be utilized as required. Unless otherwise noted, cables from other reputable manufacturers will be considered acceptable only if data sheets are submitted and approved by the AV Engineer prior to installation. Contractor must verify cable lengths and confirm the suitability of the cables listed above. Where signal loss is beyond anticipated norms, the Contractor shall coordinate with manufacturers and the Engineer to select a cable that will meet or exceed the requirements. No exceptions.

Z. Unless otherwise noted, all HDBT applications shall utilize shielded CAT6A cable and shielded connectors for 1080p. For 2k and 4k resolution applications, category cable that can verifiably pass a 100 meter HDBT test is required. If the Contractor is unsure as to the specific meaning or intent of this requirement, they should contact the consultant using the pre-bid RFI process. Cable and connectors that are not approved and installed shall be replaced at no charge to the Owner. All patch cords must be at the identical specification (or better) of the cable and connectors used for the HDBT homeruns. No exceptions!

AA. Unless otherwise noted, all analog video and computer video cables are to be terminated using seventy-five ohm (75.0 Ω) connector.

BB. Cables running in plenum areas without conduit shall be plenum rated cable; match the specified cable above. It is the responsibility of the bidder to inspect the electrical drawings and verify in what spaces plenum cable shall be used. No claims for additional monies, based on the use of plenum cable, will be allowed.

CC. All cables (except video and pulse cables which must be cut to an electrical length) shall be cut to the length dictated by the run. No splices shall be permitted in any pull boxes without prior permission of the AV Engineer. For equipment mounted in drawers or on slides, the interconnecting cables shall be provided with a service loop of appropriate length based on the bend radius of the cable.

3.6 CONNECTION PLATE RECEPTACLES

A. Unless otherwise detailed herein, the following types of panel receptacles shall be used on all connection boxes, panels, plates, and wire ways:

Audio (microphone or line level - Input only) - XLR type
Audio (loudspeaker level) - Polarized locking connector. (Neutrik Speakon)
Data, Serial (RS-232, 422, 485) - DB-9 or as noted on the drawings
Data, LAN RJ-45
Line Level Audio – RCA, .25” Tip Ring Sleeve (TRS)
Composite and 3G-SDI Video – BNC
Coaxial & Triax: BNC
CATV – RF
VGA – HD15
DVI-D – DVI-D or DVI-I
HDMI – HDMI
DisplayPort – DisplayPort, dual-mode
CAT6A – RJ-45 Shielded
Fiber Optics: as shown in the drawings or required by active components.

3.7 PATCH PANELS

A. All patch panels shall be wired so that signal "sources" (outputs from) appear on the upper row of a row pair; and all "loads" (inputs to) appear on the lower row of a row pair.

B. All audio and video patch panel designation strips shall utilize alphanumeric identifications and descriptive information. The jack position in each horizontal row shall be numbered sequentially from left to right. The horizontal jack rows shall be lettered sequentially from top to bottom. The alphanumeric identification of each jack shall be included on the functional block drawings, as well as on reproductions of these drawings, which shall be mounted in an appropriate location near the patch bays.

3.8 GROUNDING

A. In order to minimize problems resulting from improper grounding, and to achieve the maximum signal-to-noise ratio, the following grounding procedures shall be adhered to:

1. System Grounds:

    a. A single primary "system ground" shall be established for the systems in each particular area. All grounding conductors in that area shall connect to this primary system ground. The system ground shall be provided in the audio equipment rack for the area and shall consist of a copper bar of sufficient size to accommodate all secondary ground conductors.
    b. Under no conditions shall the AC neutral conductor, either in the power panel or in a receptacle outlet, be used for a system ground.

2. Audio Cable Shields:

   a. All audio cable shields shall be grounded at both ends. If a ground loop cannot be eliminated then an isolating transformer shall be utilized. For inter and intra-rack wiring this requires that the shield be connected at both ends. Chassis to rack ground shall be utilized if a ground loop can be detected either audibly or with an oscilloscope.

3. General:

   Because of the great number of possible variations in grounding systems, it shall be the responsibility of the Contractor to follow good engineering practice, as outlined above, and to deviate from these practices only when necessary to minimize crosstalk and to maximize signal-to-noise ratios in the audio, video, and control systems.

   All connectors/terminations shall be isolated from wall plates, rack plates.

3.9 AV CONTRACTOR SYSTEM CHECKOUT

A. Before Acceptance Tests are scheduled, the Contractor shall perform a complete system checkout.

B. Documentation and Verification tests shall be based off “ANSI/InfoComm 10:2013 – Audiovisual Systems Performance Verification”.

1. A verification report shall be issued based on the outcome of the system’s performance. Contractors shall acknowledge conformance to the Standard and include the specific information described therein.

C. The Contractor shall furnish all required test equipment and shall perform all work necessary to determine and/or modify performance of the system to meet the requirements of this specification. This work shall include the following:

1. Provide documentation that all matrix switching cross-points have been tested and verified.
2. Test all audio and video systems for compliance with the Performance Standards, using the following test equipment for each input and circuit:

   a. Video:

      1) Quantum Data 780 Category cable tester, required for HDBT cable compliance
      2) Sencore Optical Tri-stimulus Color OTC100 Analyzer or newer, when required. (Video display calibration for LCD and projector units)
      3) Video test signal generator, Extron VTG 400 DVI, required.
      4) Professional Blu-ray player (HDMI), with associated AV Blu-ray test discs
      5) Computer with the following outputs:

         a) HDMI
         b) DisplayPort++
         c) VGA w/ stereo 3.50 mm jack

b. Video cable

1) Set of 75.0 Ω terminators, 'T' pieces, set of video adapter connectors (such as RCA-BNC, BNC-RCA),
2) Assorted prewired cables including DVI-D, DisplayPort, HDMI, VGA, CAT6A

3. High Resolution Signals:

a. Connect the video output of the signal generator to all possible source connection points (i.e. floor-box, poke-thru, wall plates, table cubby, head-end rack) and select the SMPTE, PLUGE, Moiré signals at various video resolutions and scan rates. The example resolutions listed below are typical resolutions. All resolutions that are applicable to the project must be tested to ensure correct operation.
b. The contractor shall provide to the AV Engineer one (1) week prior to acceptance testing, a copy of the following test results in electronic format in order to verify the AV video equipment has been installed and configured correctly:

The number of HDCP KSVs Keys supported by each source.

1) The video timing, HDCP use and audio format of each source when operating.
2) The video timings and supported audio formats for each connected sink.
3) The video timings and supported audio formats presented in the EDID to each source – the preferred video timing shall be indicated.
4) The length of cable used on all shielded twisted pair cable used for AV distribution.
5) The data rate supported by each shielded twisted pair cable used for AV distribution.

c. Check that the image is correctly displayed on the video monitors and/or the video projector.
d. Test each input using Crosshatch signal, checkerboard signal, Moiré and "H" pattern signals at the scan rates indicated in items above.
e. Repeat tests for analog RGBHV and other signals at each connection location.

4. Blu-ray / Universal Format Players

a. Insert the pre-recorded disc into the deck and check operation of the control panel's transport controls as well as picture image quality. Also check that the audio signal is heard from the left and right speakers.
b. Check that the transport controls are logically presented on the touch screen GUI.
c. Re-select the SMPTE & PLUGE signal output of the video signal generator.
d. Check that the audio and video signals are recorded and can be played back on the picture monitor(s) and/or the video projector and the left and right speakers.

5. Audio check:

a. Class 1 spectrum analyzer must be capable of site calibration and verifiable test results. No exceptions.
b. Audio Precision P1PLUS Audio Analyzer or equivalent.
c. Waveform signal generator: frequency sweep, pink noise and other pertinent test signals
d. Compact, or Blu-ray discs, one technical (containing frequency sweeps, white noise, pink noise) and one music/program material.

6. Audio cable assortment

    a. Set of terminations, adapters
    b. Adjust all systems (starting at source equipment and terminating at the power amplifiers) for maximum gain and minimum distortion.
    c. Connect the output of the audio signal generator to a floor-box/table cubby/rack 'Left' and 'Right' connectors, or the 3.50 mm stereo mini connector and select the 1.00 kHz tone. Check that the signal is emitted from the left and right program speakers in the correct orientation.
    d. Repeat items for other audio connection locations.

D. At the conclusion of the tests, return all equipment settings to previously calibrated positions.

1. Submit documented records of all test results in spreadsheet form.
2. Check all control functions, from all controlling devices to all controlled devices, for proper operations.
3. Adjust, balance, and align all equipment for optimum quality and to meet the manufacturer's published specifications. Establish and mark normal settings for all level controls, and record these settings in the "System Operation and Maintenance Manual".
4. Check all optical projection images for average light level, light fall-off, and image alignment and size to comply with the Performance Standards and specifications drawings. Check to determine that all projectors, projector bases, carts, tables, and mirrors are rigid and vibration-less in operation.
5. Maintain documentation of all performance tests for reference by the AV Engineer during the System Acceptance Tests.
6. The Contractor shall forward to the Architect and the AV Engineer a complete list of test equipment available to the AV Contractor for the Testing and Commissioning indicating the equipment type (i.e. 1/6th octave real time analyzer, 1/12th octave fast Fourier transform (FFT) analyzer, video test signal generator.) including manufacturer's name, model number, and relevant calibration information. If such test equipment is capable of multiple comprehensive automated tests, the Contractor shall detail the complete range of tests that the equipment can perform.
7. The Contractor shall forward to the Architect and to the AV Engineer a complete description of the Testing and Commissioning procedure, which the Contractor will use. This must include a complete description of the equipment connections, locations of measuring equipment, locations of transducers (loudspeakers, microphones, optical measuring tools), locations of signal generators and methodology for establishing the testing procedure.

E. The following list of Test Equipment is not exhaustive, but it known that a successful A/V installation of the type specified here cannot be properly commissioned without the Contractor using the following list of Test Equipment/functions:

1. True RMS Voltmeter with measurements in decibels, linear to 100 kHz, required (i.e. Fluke 8060A or equivalent).
2. 250 MHz dual trace oscilloscope, with external video trigger capabilities, required.
3. 1/6th Octave Real Time Acoustical Analyzer, with a minimum of six (6) curve integration averaging or 1/6th Octave filter set for Integrating Type 1 sound level meter, both with microphone calibrator, required.
4. Pink and white noise, sine wave (variable frequency) and sweep generator, with variable output: -60.0 dB-V to +4.00 dBm, required.
5. Loudspeaker line impedance meter, with readouts at ISO octave band frequencies, required.
6. Loudspeaker phase meter- clicker, required.

7. Audio signal test measurement set, for measurement of Signal to Noise ratio (S/N), Total Harmonic Distortion (THD), inter modulation distortion, frequency response (both electrical and acoustical), phase response, wow and flutter and impedance versus frequency (i.e. Audio Precision One, Neutrik A2-D units are recommended).
8. Acoustical test set, for measurement of RT60, early to late reflections ratio, loudspeaker polar and frequency response, loudspeaker time alignment/delay, STI-PA, (i.e. MLSSA, CLIO, B&K class 1 type units).
9. Data cable sweep generator: Perform and document certification testing all AV related CAT5e, CAT6a TP cables used for the distribution of AV and control signals. (See Division 27 Communications specification sections for requirements)

F. Test all audio for compliance with the Performance Standards.

1. Provide the AV Engineer “Before” and “After” spreadsheet and graphical frequency response test results for a representative quantity of each speaker type or zone, a minimum of one (1) week prior to the final acceptance site testing.
2. Check all control functions, from all controlling devices to all controlled devices, for proper operation.

G. Adjust, balance, and align all equipment for optimum quality and to meet the manufacturers’ published specifications. Establish and mark normal settings for all level controls and record these settings in the "System Operation and Maintenance Manual".

H. Loudspeaker Equalization:

1. General Testing and Adjustments

a. Test each loudspeaker circuit or zone extensively and individually for uniform Sound Pressure Levels and adjust the system as necessary.
b. Perform all tests and adjustments required to obtain specified performance. Tests and adjustments shall be performed under the following conditions:
c. When all ceiling tiles, acoustical sound screens, furniture, and all other items are in their final position and ready for personnel. HVAC and lighting shall be operating at normal conditions.
d. Fine-tuning of equalization system may also be needed to accommodate any inconsistencies in interior layout as the curve described below was constructed for an ideal open office environment. Consult this specification for the specific equalization curve to use once furniture installation has taken place.
e. Using an AC impedance meter or bridge, measure all loudspeaker circuit’s impedance at 1.00 kHz while disconnected from the amplifier output and note the data. This will assure that the speaker circuits are free of faults and will not overload the amplifier.
f. Measure the ambient sound level in 1/3rd octave bands with all HVAC systems and lights on. Record data as 1/3rd octave band readings. Also measure and record the ambient sound level as a single wideband "A" weighted (dB-A) reading.
g. With the pink noise (or sweep generator) off and power amplifier on, and with all volume controls set an 80.0 % rotation (or +80.0 dB) in all areas, the system hum and noise must be inaudible. Any mechanical rattles or audio distortion must be corrected at this time.
h. Apply the pink noise or sweep generator signal to system and adjust for a working level for the equalization of the system of at least +20.0 dB above ambient sound level. Staff must use ear protection.
i. Check for uniformity of coverage by measuring utilizing a 32-band 1/6th octave Class 1 spectrum analyzer. The level in all areas must not deviate more than +/- 2.00 dB-A. Correct any out of tolerance deviations before proceeding.

j. Document all findings and resultant frequency curves and graphs for each of the zone channels.

2. System Ring-out (Feedback reduction): Once the sound system has been equalized to obtain a flat response, ring-out each microphone input using the following procedure or similar:

a. Attach oscilloscope to the output of the sound system
b. Put on ear protection.
c. Turn on one (1) microphone
d. Raise system volume unit feedback begins.
e. Use the oscilloscope to find the largest peak.
f. Add a very narrow parametric filter to “notch” out that frequency on the corresponding microphone channel.
g. Repeat feedback procedure to eliminate several feedback frequencies. When using wireless microphones, be sure to walk about the space to excite other potential feedback frequencies.
h. Once feedback has been essentially eliminated from that microphone, (in software) add a compression module or block with moderate compression ratio, attack and release settings. When the microphone is used the effect shall not be noticeable.
i. Verify that the compression algorithm has not altered the feedback suppression in place.
j. Test next microphone input(s) using the same general procedure.

3.10 SYSTEM ACCEPTANCE TESTS

A. Contractor shall notify Architect / Owner and AV Engineer of intent to test a minimum of (2) weeks prior to proposed test date.

B. System Acceptance Tests shall be conducted with the Architect / Construction Manager / Owner (or their representatives) and the AV Engineer present as witness.

C. In the event further adjustment is required, or defective equipment must be repaired or replaced, tests may be suspended or continued at the option of the AV Engineer, Architect, and/or the Owner. The Contractor can and shall be responsible for the AV Engineer’s expenses such as, but not limited to: lodging, travel, airfare, and the AV Engineer’s billable time.

END OF SECTION

APPENDIX 1 - EQUIPMENT SCHEDULE

NOTE: All product numbers indicated below were coordinated with the benchmark manufacturers prior to document issuance. However, the AV Contractor shall verify that all listed product numbers comply with the performance requirements indicated within this specification section and that all products submitted are the most current products offered by the manufacturer.

Table 1 – Audio Visual Products			
Item	Part Name/Description	Manufacturer	Part Number
Wellness Center			
1	65” Flat panel display	Samsung	QB65B
2	Display wall mount	Chief	MTM1U
3	In-wall back box	Chief	PAC526
4	Apple TV	Apple	Apple TV 4K
5	Loudspeakers	Biamp	CM60DTD
6	Amplifier	Crown	DCI 2|300
7	DSP	Biamp	TESIRA FORTE DAN AI
8	Bluetooth wall plate	Atterotech	UnD6IO-BT
9	Media player	Bluesound	B100S
10	Control Processor	Crestron	RMC4
11	Control Panel	Crestron	TSW-1070-X-S
Elevator Lobbies / Wayfinding Displays			
1	85” Flat panel display	Samsung	QB85B
2	Display wall mount	Chief	LTM1U
3	In-wall back box	Chief	PAC526
4	Wayfinding digital signage player	Brightsign	XD SERIES
5	HDMI patch cables	Crestron	CBL-HD
Atrium			
1	Loudspeakers	Biamp	CM60DTD
2	Loudspeakers	Biamp	MASK2
3	Amplifier	Crown	DCI 4|300
4	Media player	Bluesound	B100S
5	Assisted Listening System	Sennheiser	MOBLIE CONNECT
6	ALS connection tablet	Lenovo	TAB M8
7	DSP	Biamp	TESIRA FORTE DAN AI
8	XLR and AUX wall plate	Biamp	D-ALINP
9	Wired Microphone w/ Podium Mount	Sennheiser	E 935
10	Wireless microphone Receiver	Sennheiser	SL MCR 2 DW-2
11	Wireless microphones	Sennheiser	865 DW-4-US
12	WM charging station	Sennheiser	CHG-2N US
13	Control Processor	Crestron	CP4N
14	Control Panel	Crestron	TSW-1070-X-S

Judge's Chamber			
1	65" Flat panel display	Samsung	QB65B
2	Display wall mount	Chief – Articulating	TS325TU
3	In-wall back box	Chief	PAC526
4	Video conferencing soundbar	Polycom	X30
5	USB Mouse (Bluetooth)	HP/Logitech or equal	N/A
6	Wireless presentation	Crestron AirMedia	AM-3200
7	HDMI patch cables	Crestron	CBL-HD
8	Table box HDMI interface (passthrough or plate)	Crestron	FT2 Series or equal. Coordinate with furniture.
9	HDMI Transmitter	Crestron DM Lite	HD-TXU-4KZ-211-CHGR
10	HDMI Receiver	Crestron DM Lite	HD-RX-101-C-E
Judge's Workroom			
1	65" Flat panel display	Samsung	QB65B
2	Display wall mount	Chief	MTM1U
3	In-wall back box	Chief	PAC526
4	Video conferencing soundbar	Polycom	X30
5	Wireless presentation	Crestron AirMedia	AM-3200
6	HDMI patch cables	Crestron	CBL-HD
7	Table box HDMI interface (passthrough or plate)	Crestron	FT2 Series or equal. Coordinate with furniture.
8	HDMI Transmitter	Crestron DM Lite	HD-TXU-4KZ-211-CHGR
9	HDMI Receiver	Crestron DM Lite	HD-RX-101-C-E
10	Control Panel	Polycom	TC10
Small Conference Rooms, Small Mediation Rooms			
1	75" Flat panel display	Samsung	QB75B
2	Display wall mount	Chief	LTM1U
3	In-wall back box	Chief	PAC526
4	Video conferencing soundbar	Polycom	X52
5	Wireless presentation	Crestron AirMedia	AM-3200
6	HDMI patch cables	Crestron	CBL-HD
7	Table box HDMI interface (passthrough or plate)	Crestron	FT2 Series or equal. Coordinate with furniture.
8	HDMI Transmitter	Crestron DM Lite	HD-TXU-4KZ-211-CHGR
9	HDMI Receiver	Crestron DM Lite	HD-RX-101-C-E
10	Control Panel	Polycom	TC10
11	Room Scheduler	Crestron	TSS-770-X-S-LB-KIT
Medium Conference Rooms, Medium Mediation Rooms			
1	85" Flat panel display	Samsung	QB85B
2	Display wall mount	Chief	LTM1U
3	In-wall back box	Chief	PAC526

4	Video conferencing system	Polycom	G7500
5	PTZ camera	Polycom	Studio E70
6	Wireless presentation	Crestron AirMedia	AM-3200
7	Loudspeakers	Biamp	CM60DTD
8	Amplifier	Crown	DCI 4|300
9	DSP	Biamp	Tesira Server I/O
10	Microphone	Shure	MXA920
11	Control Processor	Crestron	CP4N
12	HDMI patch cables	Crestron	CBL-HD
13	Table box HDMI interface (passthrough or plate)	Crestron	FT2 Series or equal. Coordinate with furniture.
14	NDI to HDMI Converter	Birddog	FLEX4KOUT
15	Encoder/Decoder Chasis	Crestron w/ Cards	DMF-CI-8
16	HDMI Encoder	Crestron NVX	DM-NVX-363
17	HDMI Decoder	Crestron NVX	DM-NVX-363
18	Control Panel	Polycom	TC10
19	Room Scheduler	Crestron	TSS-770-X-S-LB-KIT
Large Conference Rooms, Large Mediation Rooms			
1	85” Flat panel display	Samsung	QB85B
2	Display wall mount	Chief	LTM1U
3	In-wall back box	Chief	PAC526
4	Video conferencing system	Polycom	G7500
5	PTZ camera	Polycom	Studio E70
6	Wireless presentation	Crestron AirMedia	AM-3200
7	Loudspeakers	Biamp	CM60DTD
8	Amplifier	Crown	DCI 4|300
9	DSP	Biamp	Tesira Server I/O
10	Microphone	Shure	MXA920
11	Control Processor	Crestron	CP4N
12	HDMI patch cables	Crestron	CBL-HD
13	Table box HDMI interface (passthrough or plate)	Crestron	FT2 Series or equal. Coordinate with furniture.
14	NDI to HDMI Converter	Birddog	FLEX4KOUT
15	Encoder/Decoder Chasis	Crestron w/ Cards	DMF-CI-8
16	HDMI Encoder	Crestron NVX	DM-NVX-363
17	HDMI Decoder	Crestron NVX	DM-NVX-363
18	Control Panel	Polycom	TC10
19	Room Scheduler	Crestron	TSS-770-X-S-LB-KIT
Public Meeting Rooms			
1	85” Flat panel display	Samsung	QB85B

2	Display wall mount	Chief	LTM1U
3	In-wall back box	Chief	PAC526
4	Loudspeakers	Biamp	CM60DTD
5	Amplifier	Crown	DCI 4|300
6	DSP	Biamp	Tesira Server I/O
7	Control Processor	Crestron	CP4N
8	HDMI patch cables	Crestron	CBL-HD
9	Table box HDMI interface (passthrough or plate)	Crestron	FT2 Series or equal. Coordinate with furniture.
10	NDI to HDMI Converter	Birddog	FLEX4KOUT
11	Matrix Switcher	Crestron	HD-RX-4K-410-C-E-SW4
12	HDMI Transmitter	Crestron DM Lite	HD-TXU-4KZ-211-CHGR
13	HDMI Receiver	Crestron DM Lite	HD-RX-101-C-E
14	Control Panel	Crestron	TSW-1070-X-S
Collaboration Room 3172			
1	65” Flat panel display	Samsung	QB65B
2	Display wall mount	Chief	MTM1U
3	In-wall back box	Chief	PAC526
4	Video conferencing soundbar	Polycom	X30
5	Wireless presentation	Crestron AirMedia	AM-3200
6	HDMI patch cables	Crestron	CBL-HD
7	Table box HDMI interface (passthrough or plate)	Crestron	FT2 Series or equal. Coordinate with furniture.
8	HDMI passthrough plate	Liberty	Custom
9	Control Panel	Polycom	TC10
10	Room Scheduler	Crestron	TSS-770-X-S-LB-KIT
Training Rooms			
1	Projector	Sony	VPL-FHZ91L
2	Projector lens	Sony	VPLL-Z4015 or appropriate lens for final location
3	Projector ceiling mount	Chief	RPA W/ POLE
4	Motorized projection screen 123” diagonal	Dalite	TENSIONED ADVANTAGE
5	Video conferencing system	Polycom	G7500
6	PTZ camera	Polycom	Eagle Eye IV
7			
8	Wireless presentation	Crestron AirMedia	AM-3200
9	Loudspeakers	Biamp	CM60DTD
10	Amplifier	Crown	DCI 4|300
11	DSP	Biamp	Tesira Server I/O

12	Assisted Listening System	Sennheiser	MOBLIE CONNECT
13	ALS connection tablet	Lenovo	TAB M8
14	Wireless microphone Receiver	Sennheiser	SL MCR 2 DW-2
15	Wireless microphones	Sennheiser	865 DW-4-US
16	WM charging station	Sennheiser	CHG-2N US
17	Microphone	Shure	MXA920
18	HDMI patch cables	Crestron	CBL-HD
19	Table box HDMI interface (passthrough or plate)	Crestron	FT2 Series or equal. Coordinate with furniture.
20	NDI to HDMI Converter	Birddog	PLAY
21	Encoder/Decoder Chasis	Crestron w/ Cards	DMF-CI-8
22	HDMI Encoder	Crestron NVX	DM-NVX-363
23	HDMI Decoder	Crestron NVX	DM-NVX-363
24	HDMI Encoder 2-gang	Crestron NVX	DM-NVX-E20-2G-B-T
25	Control System	Crestron	CP4N
26	Control Panel	Crestron	TSW-1070-X-S
27	Control Panel	Polycom	TC10
28	Room Scheduler	Crestron	TSS-770-X-S-LB-KIT
Courtrooms			
1	47U Rack - Left Side Panels, Left Swing	Legrand Ortronics	B1104-061047-MDC08
2	47U Rack - Right Side Panels, Left Swing	Legrand Ortronics	B1104-061047-MDC09
3	47U Rack - Left Side Panels, Right Swing	Legrand Ortronics	B1104-061047-MDC07
4	47U Rack - Right Side Panels, Right Swing	Legrand Ortronics	B1104-061047-MDC10
5	40-Port AV Network Switch	Netgear	GSM4248PX
6	12-Port AV Network Switch	Netgear	GSM4212PX
7	10-Port AV Network Swtich	Netgear	GSM4210PD
8	28-Port AV Network Core Switch	Netgear	XSM4328FV
9	Fiber Media Converter	1G Cat6 to SMFO Transmitter	Contractor Nomintated
10	Fiber Media Converter	1G Cat6 to SMFO Receiver	Contractor Nomintated
11	75” Display	Samsung	QB75B
12	85” Display	Samsung	QB85R-B
13	Clerk and Control room Tricaster monitors	Dell	S2721QS
14	Roaming Cart Portable Display	Samsung	QB55-B
15	Recording Room Multiviewers	Panasonic	TH-55SQE2
16	Retracting Panel System & Screen Advance	Future Automation	LSH
17	E-Stop	3rd Party	Contractor Nominated

18	Large Fusion Tilt Wall Mount	Chief	LTA1U
19	Portable Voyager TV Teleconferencing Cart	Chief	LSCUW
20	Voyager Component/Video Camera Shelf	Chief	SCACW
21	Proximity Equipment Mount Plate	Chief	PACL2
22	27" Computer Monitor Swing Arm Mount	Ergotron or similar	Contractor Nominated
23	PTZ Broadcast Camera	BirdDog	P240 NDI White
24	PTZ Teleconferencing Camera (Carts)	BirdDog	P100 Black
25	HDMI Encode/Decode	BirdDog	Mini
26	HDMI to Displays	BirdDog	Flex 4K Out
27	HDMI to NDI ingest	BirdDog	4K HDMI
28	Broadcast Connectivity	BirdDog	4K Quad
29	PTZ Keyboard Controller	BirdDog	PTZ-Keyboard
30	NDI Casting Player	BirdDog	Play
31	NDI Security Purpose Camera	BirdDog	P100 WHITE
32	PTZ Wall Mount (White)	BirdDog	BD-P-WM-WHITE
33	Video Switching Processor	NewTek	1 Pro
34	Video Switching Surface	NewTek	Flex
35	Video Recorder 2	NewTek	NRSD Remote Storage Server
36	Audio Recording Platform	Court Smart	Owner Furnished
37	AV System Management & Service Computer	Intel NUC or Similar	Contractor Nominated
38	DisplayPort EDID Emulator	Lindy or Similar	Contractor Nominated
39	3G SDI to HDMI converter	Blackmagic or Similar	Contractor Nominated
40	HDMI Switcher for control room displays	Lightware	MX2-8x4-HDMI-CA
41	Microphones - Room	DPA Microphones	4098-DC-G-W01-030
42	Microphone – Wrls Receiver	Sennheiser (per court)	SL MCR 2 DW-2
43	Microphone Charging Base	Sennheiser (per court)	CHG-2N US
44	Microphones – Wrls Handheld	Sennheiser (per court)	865 DW-4-US
45	Microphone base with switch	Sennheiser	MAT 153-S
46	Microphone Gooseneck	Sennheiser	MEG 14-40-L-II B
47	Microphone Dante Embedder	Sennheiser	SL DI 4 XLR
48	Microphone Logic Switch	Biamp	Tesira EX-LOGIC
49	Amplifier	Crown	DCI 4|300
50	Amplifier	LEA Professional	168D
51	Amplifier	LEA Professional	164D
52	Loudspeakers	Biamp	CM60DTD

53	Loudspeakers	James Loudspeaker	SA63-7 Small Aperture (Customization Required)
54	Studio Monitor Controller	Heritage Audio	RAM System 2000
55	Studio Monitors Pair	Tannoy	Gold 8 Pair
56	Control System	Crestron (Converged unit for floor)	CP4N
57	Control Panel	Crestron	TS-1070-W-S
58	Video Control Surface	Skaarhoj	Live Fly
59	Assistive Listening	Sennheiser	Mobile Connect Station
60	Additional Assistive Listening Receive Devices	Lenovo	Tab M8 8"
61	HDMI patch cables	Crestron	CBL-HD
62	OpticalCon Duo Cable - Short	Neutrik	NKO2S-L-0-3
63	OpticalCon Duo Cable - Long	Neutrik	NKO2S-L-0-25
64	OpticalCon Duo SDI to Fiber Converter	Theatrixx	XVVSDI2FIBERT1-12G-S2
65	OpticalCon Duo Fiber to SDI Converter	Theatrixx	XVVFIBER2SDIT1-12G-S2
66	DSP Frame	Biamp (Converged unit for floor)	Tesira Server I/O
67	DSP Processing Card	Biamp	DSP-2 Processing Card
68	DSP Dante Input Card	Biamp	DAN-1 Dante IO
69	DSP Analog Output Card	Biamp	SOC-4 - Line level out
70	DSP Analog Input Card	Biamp	SIC-4 Analog Input
71	DSP Echo Cancellation Processing Card	Biamp	SEC-4 Input with Echo Cancellation
72	DSP Analog Input Card w/ Ambient Noise Compensation	Biamp	SAC-4 Input with Ambient Noise Reduction
73	Patch connector, XLR Male	Neutrik	NC3MD-L-B-1
74	Patch connector, XLR Female	Neutrik	NC3FD-L-B-1
75	Patch Connector, Cat6A	Neutrik	NE8FDX-P6
76	Patch Connector, OpticalCon Duo	Neutrik	NO2-4FDW-A
77	Patch Connector, ST Simplex Fiber	L-Com	FOA-001A
78	Custom Patch Panel (Refer to AV Patch Panel Documentation)	Whirlwind	
79	Floorbox - Isolated backbox	Ace Backstage	ISO1048BBX (Reference Quote 00126770 for further detail)
80	Floorbox - Patching Box Insert	Ace Backstage	124M2BK-FF (Reference Quote 00126770 for further detail)
81	Floorbox - Mounting Panel for duplex electrical	Ace Backstage	PE-MP (Reference Quote 00126770 for further detail)
82	Floorbox - Mounting Panel for fiber	Ace Backstage	PNL-104 (Reference Quote 00126770 for further detail)

83	Floorbox - Mounting Panel for connectors	Ace Backstage	PNL-1212 (Reference Quote 00126770 for further detail)
84	Electrical back box for patch panel	Hoffman	ASE18X18X6NK
85	Custom Patch Panel for Recording Desk	Whirlwind	18x18BK Custom Patch Panel
AV/I.T. Rack Rooms			
1	AV Network Switch POE	Netgear AV	24-48 port Dante compatible POE AV network switch

APPENDIX 2 – SPECIFICATION COMPLIANCE MATRIX TEMPLATE

Indicate compliance of the proposed equipment and/or services by the word "Comply" following each paragraph number. Indicate an exception to the requirement by the word "Exception" following the applicable paragraph number. Should the proposed equipment and/or services not entirely comply with the requirements specified, but ultimately achieve the intent, the Bidder shall explain fully the extent, or lack thereof, of compliance for the applicable equipment and/or services proposed. Instances where there is no indication of compliance or exception shall be considered non-compliant.

Contractor shall submit Compliance Matrix with the Bid Proposal AND at the time of Product Data submittal (as indicated previously in this specification) so that a complete system submittal reviewed can be performed. Contractor shall use the following template to create a full Compliance Matrix for each specification section.

	COMPLIANCE	**EXPLANATION**
PART 1		
1.1		
A	COMPLY	
B	EXCEPTION	Note clarifications and/or reason for exception here.
C	COMPLY	
1.2		
A.1	COMPLY	
A.2	COMPLY	
B	COMPLY	
C.1	COMPLY	
C.2	COMPLY	
D.1a	COMPLY	
D.1b	COMPLY	
D.2a	COMPLY	
xx	COMPLY	
xx	COMPLY	

APPENDIX 3 – PRODUCT DATA & SHOP DRAWING SUBMISSION CHECKLIST

NOTE: Contractor shall utilize checklist below to ensure comprehensive product data and shop drawings are submitted for review, including submittals compiled between multiple sub-contractors (as applicable). This checklist is intended help establish submittal expectations specific to each specification section and to serve as a pre-check document for each contractor. Refer to submittal section of these specifications for additional requirements.

	GENERAL ITEMS:
	Compliance matrix
	Proposed project schedule (procurement, installation, final testing/punch, etc.)
	PRODUCT DATA:
	Manufacturer warranty information
	Equipment component list
	Equipment specification sheets
	SHOP DRAWINGS
	27 41 00
	All Div.27 AV submittal sections to be submitted together
	Legend: indicate symbol key, labeling scheme, scope clarification notes, etc.
	One-lines: indicate detailed connectivity one-lines depicting all components, wiring, connections, etc.
	Site plan: indicate OSP cable routes, device locations, light and/or speaker poles, etc.
	Floor plans: indicate component locations and sizes (racks, raceway, active components, etc.),
	device labels, typical conduit / cable paths, etc.
	RCPs: indicate current ceiling layer, ceiling device placement, lifts, access hatches, etc.
	Elevations: indicate AV rack elevations with detailed equipment layouts
	Details: indicate final connection plate details, equipment mounting details, etc.
	27 41 40
	All Div.27 AV submittal sections to be submitted together
	Legend: indicate symbol key, labeling scheme, scope clarification notes, etc.
	One-lines: indicate detailed connectivity one-lines depicting all components, wiring, connections, etc.
	Floor plans: indicate device locations, device labels, cable types and distances, back-box sizes, etc.
	Elevations: indicate wall elevations with detailed equipment layouts (amps, splitters, taps, etc.)
	Details: indicate final connection plate details, equipment mounting details, etc.

SECTION 27 53 20 - DISTRIBUTED ANTENNA SYSTEMS GENERAL REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

B. This 27 53 20 specification section is intended to cover requirements that apply to multiple wireless systems including Cellular, Emergency Responder Radios, and Facility Radios. Not all requirements noted within this specification section are applicable to all three systems. Refer to the specification section 28 50 20 for additional requirements specific to the Emergency Responder Radio Systems (ERRS).

1.2 SUMMARY

A. The awarded DAS Provider / Vendor shall provide a neutral-host, carrier grade, carrier approved DAS that meets the most current Cellular Carrier requirements for coverage and capacity. Additionally, DAS shall meet or exceed current league and/or sports venue industry standards from a wireless coverage and capacity standpoint, including latest fan facing bandwidth recommendations for both upload and download speeds to mobile devices.

B. The awarded DAS Provider / Vendor may also be selected to provide Emergency Responder Radio Systems (ERRS) and Facilities Radio Systems (FRS) that are independent of the cellular DAS, given the more stringent NFPA code requirements for pathway survivability. (Note: If DAS Provider elects to share select DAS components such as fiber optic backbone or remote units, this shall be included as an alternate for consideration as part of the RFP response.)

C. The Contractor shall provide all necessary MEP support systems associated with fit-out of Wireless Equipment Room (WER) including HVAC, power distribution, and fire suppression to support DAS head-end and distribution equipment. (Note: MEP support systems in intermediate Telecom Rooms (TR) have been included in the base building cost, but any additions or upgrades required by the DAS will shall be provided at DAS Vendors' cost.)

D. Contractor shall provide all necessary legal contracts, coordination and service requirements with Cellular Carriers. These shall include but not be limited to all DAS technical requirements necessary to interface with originating base stations, transport the signal, and transmit the signal throughout building and exterior.

E. Reference to Distributed Antenna System shall be referred to as DAS from this point forward.

F. Reference to Emergency Responder Radio Systems including Fire Department, Police Department, Ambulance, First Responders, and any other Emergency Responder shall be referred to as ERRS from this point forward.

G. Reference to Facility Radio Systems including Building Operations and Security shall be referred to as FRS from this point forward.

H. Reference to Contractor, Installer, Integrator, Vendor, and/or Manufacturer shall be referred to as Contractor from this point forward.

I. The term “provide” used throughout this specification and drawings shall mean “furnish, install, test, and certify”.

J. The Contractor shall provide complete procurement options for system cost, installation, support, warranty, revenue share, and Cellular Carrier contract options to the Owner. Procurement options may include Owner Operated, Contractor Operated, leasing, etc.

K. Contractor shall fully coordinate with Authority Having Jurisdiction (AHJ) including all necessary system requirements, frequency allocations reviews, and approvals frequency allocations with Building Department, Fire Department, Police Department, and/or other departments for determining ERRS. The AHJ may require a separate DAS for ERRS and Contractor shall provide system as required.

L. This project may be implementing a phased construction schedule. The Contractor shall meet with the Owner and Construction Manager (CM) to review the construction schedule and associated areas of work. All necessary labor, cable, terminations, components, and equipment shall be provided to accommodate temporary, phased, and final conditions as required.

M. Contractor shall coordinate project schedule, installation schedule, phasing and any other requirements deemed necessary with Owner, CM, and all necessary Trades to ensure successful completion of work.

N. Phasing, temporary distribution/equipment, cut-over and implementation shall be coordinated with Owner, CM, and Architect.

O. This specification is not intended to contain proprietary information or requirements based on any specific Vendor and/or Manufacturer system or approach. Any proprietary information included in this specification is unintentional.

P. Contractor shall design, furnish, install, and configure a turnkey DAS, Cellular Carrier interfaces, ERRS, and FRS head-end equipment, and system management and monitoring software. Work shall include all necessary radio frequency design, fiber optic backbone, DAS system components and installation thereof required including raceway, cable, cable terminals, transceivers/media converters, amplifiers, equipment, fireproofing, etc. for a fully operational and functional DAS.

Q. The DAS shall include all head-end equipment, base station equipment, amplifiers, signal repeaters, PSTN backhaul, and DAS interfaces for Emergency Responders (Police, Fire, and EMS) and Facility two-way communications radio systems.

R. The DAS shall include a real-time management and monitoring software control system. This control system shall be set up and fully configured.

S. This work shall include but not limited to onsite wireless/RF studies, virtual antenna placement, physical design of DAS, submittals, physical coordination, equipment, and installation.

T. An onsite wireless/RF study shall be provided by Contractor to establish existing signal strengths and potential interfering sources including Cellular Carrier, Emergency Responder, and Facility Radio requirements and radio frequencies.

U. The DAS design shall be (virtually) developed, modeled and optimized using wireless computer software such as iBwave for establishing antenna locations based on electronic architectural drawings and various wireless frequency bands. Construction materials shall be inputted into the software program for structure, walls, floors, and ceilings.

V. The DAS wireless coverage and signal strength shall be field tested and verified, certified, and guaranteed upon installation against design requirements including coordination with Cellular Carriers and Emergency Responders.

W. The DAS shall be designed to support and fully connect Cellular Carriers and Service Providers such as AT&T, Sprint/Nextel, T-Mobile, and Verizon Wireless and other local Cellular Carriers.

X. The Contractor shall coordinate support systems requirements directly required by the DAS such as architectural, HVAC, electrical, and technology systems.

Y. Placement of any equipment including antennas, cable, and electronics shall be coordinated with Owner, Architect, Engineer, Construction Manager, and other Construction Trades to ensure neat and functioning installation.

Z. All antenna locations and cable routing shall be coordinated by the Contractor with the Owner, Architect, ME Engineers, and Construction Manager prior to installation to maintain the highest level aesthetics sought on this project. The Contractor shall position antennas discreetly. Contractor shall provide mockups for each unique mounting and routing condition for Owner and Architect approval including associated shop drawings and references for each location.

AA. The installation of the DAS system shall comply with all local building codes, and applicable rules and regulations of the AHJ, FCC, BICSI, EIA, IEEE, NEC, TIA, UL, IFC, NFPA and other industry standards, codes, and methods.

BB. Any DAS distribution through exposed public areas shall be routed in continuous conduit painted (or stealth) to match surrounding background or conditions. All such conditions shall be approved by Owner, Architect, and ME Engineers prior to initiating any work.

CC. Extent of DAS work is indicated by Division 27 Specifications and Technology DAS (TD) drawings and schedules and is hereby defined to include, but not by way of limitation, the provisions of:

1. The Contractor shall provide all necessary DAS equipment, head-end room fit-out, power supply equipment and cabling, backbone and horizontal cabling and raceway systems and all grounding required for the DAS. Select components have been planned for and included in the base building design at no cost to the DAS Provider. This includes, but is not limited to, space allocation in Telecom Rooms (TR), cable tray and major backbone conduits to connect DAS head-end room to all building TRs, and in some cases select conduit segments to cross concourses or feed up to top of seating bowl or canopy. (Refer to Technology DAS “TD” drawings for additional information.)
2. The Contractor or their Sub-Contractor performing work shall determine how the scope of work is assigned. The purpose of this specification is to establish design intent and general system scope.
3. All physical cable management hardware including, but not limited to: “Butterfly” clips attached to exposed steel or concrete, “J-hooks” in accessible ceiling areas, “D-rings” on backboards, horizontal managers in racks and cabinets within equipment rooms, etc.
4. Fire stopping as required.
5. Testing of system, components, and infrastructure as noted by specification, drawings, and applicable industry standards.

6. Testing of all grounding systems as noted by specification, drawings, and applicable industry standards.
7. Labeling of all system equipment, components, hardware, cable, and terminations with mechanically printed labels.
8. Preparation and submission of product data, shop drawings, testing reports, as-built drawings, and cabling documentation as required in this specification.
9. Construction and Installation warranties.
10. Manufacturer components, channel and solutions warranties.
11. Installation and testing of all system and components.
12. Preparation of maintenance plan recommended by system Manufacturer.

1.3 ACRONYMS AND ABBREVIATIONS

A. Provided below is a general list of typical acronyms and abbreviations:

1. 3G: Third Generation mobile telecommunications
2. 4G: Fourth Generation mobile telecommunications
3. 5G: Fifth Generation mobile telecommunications
4. AHJ: Authority Having Jurisdiction
5. ARPU: Average Revenue Per User
6. BICSI: Building Industry Consulting Services International
7. BTS : Base Transceiver Station
8. CD: Construction Documents or Contract Documents
9. CDMA: Code Division Multiple Access
10. CM: Construction Manager
11. DAS: Distributed Antenna System
12. ERRS: Emergency Responder Radio System(s)
13. FCC: Federal Communications Commission
14. FRS: Facilities Radio Systems
15. GC: General Contractor
16. GPS: Global Positioning System
17. GSM: Global System for Mobile Communications
18. iDEN: Integrated Digital Enhanced Network
19. IEEE: Institute of Electrical and Electronics Engineers
20. LMR/SMR: Land Mobile Radio/Specialized Mobile Radio
21. LTE: Long Term Evolution mobile broadband telecommunications
22. MEP: Mechanical, Electrical and Plumbing Systems
23. MEPT: Mechanical, Electrical Plumbing, and Technology Systems
24. MTR: Main Telecom Room (commonly referred to as MDF)
25. MIMO: Multiple Input / Multiple Output
26. NEC: National Electrical Code
27. PoE: Power over Ethernet
28. POI: Point of interface
29. PSTN: Public Switched Telephone Network land based telecommunications providers i.e. Telephone Company.
30. RF: Radio Frequency
31. SHF: Super High Frequency (3-30 GHz)
32. SISO: Single Input / Single Output
33. TDMA: Time Division Multiple Access
34. TR: Telecom Room (commonly referred to as IDF)
35. UHF: Ultra High Frequency (300-3000 MHz)
36. VHF: Very High Frequency (30-300 MHz)
37. WCDMA: Wideband Code Division Multiple Access

38. WER: Wireless Equipment Room
39. WLL: Wireless Local Loop

1.4 SUBMITTALS

A. General Description and Requirements:

1. In addition to the requirements noted herein, refer to base RFP document and Division 1 Specification (as applicable) for additional requirements.

B. Revenue Models: Contractor shall provide cost models and options for revenue sharing to Owner from contracts with Cellular Carriers.

C. Product Data: The DAS Product Data Submittal shall be submitted for review and approval by Owner, Architect, and ME Engineers prior to starting any work. Information shall include detailed parts list for all components and manufacturer's product data for each component to be installed.

D. Virtual Wireless Model: After project award, provide plan drawings based on architectural background or model indicating device and antenna placement based on wireless modeling computer software. Construction materials shall be inputted into the software program for structure, walls, floors, and ceilings as well as radio frequencies, zones, and capacity to help predict coverage and placement of antennas and associated coverage patterns. Information submitted shall include coverage drawing (heat map) as well as placement of antennas, equipment, and associated cable routing, etc. Models shall be developed using iBwave or equivalent industry recognized software.

E. Field Test Reports: Indicate and interpret test results for compliance with performance requirements of installed systems as well as acceptance by all Cellular Carriers and Emergency Responders.

F. Commissioning: The Contractor shall complete commissioning of the system and issue a final report. Commissioning shall be performed upon completion of system, and after its testing and retuning. Report shall be completed and finalized by the Contractor prior to system acceptance by Cellular Carriers and Owner. A formal report shall be generated that includes sign-off and notes of all checklist items.

G. Warranties: The Contractor shall provide a warranty on all parts, components, and labor Warranty period shall start based on acceptance by Owner upon completion, testing and acceptance of the installation by the Wireless Carriers. Refer to section 1.12 Warranty for additional requirements including time durations.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: The installation supervisor for both installation and maintenance of units required for this Project must be an experienced installer who is an authorized representative of the DAS Vendor.

1. Contractors shall have at least five (5) years of successful installation experience with projects utilizing wireless systems including DAS.
2. The company shall be a certified installer of the DAS manufacturer, and shall provide a 1-year warranty on installation/applications.

B. Electrical Components, Devices, and Accessories: These shall be listed and labeled as defined in NFPA 70, NEC, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use. All materials shall be Underwriters Laboratories (UL) Listed unless otherwise noted or required by AHJ.

1.6 CODES AND STANDARDS

A. All work including materials and installation shall conform to all applicable sections of currently adopted editions of the codes and standards listed below or the codes, standards and specifications published by the organizations listed below:

1. Uniform Building Code (UBC).
2. State and local codes.
3. ANSI: American National Standards Institute (ANSI).
4. ANSI/EIA/TIA standards as applicable to DAS.
5. ASTM: American Society for Testing and Materials
6. BICSI TDM Telecommunications Distribution Methods Manual (current edition).
7. BICSI Wireless Design Reference Manual (current).
8. Cellular Carrier Requirements as determined by AT&T, Sprint, T-Mobile, Verizon Wireless, and other local Cellular Carriers.
9. Emergency Responder Requirements as determined by AHJ, Fire Department, Police Department, and Ambulance/EMS.
10. ICEA: Insulated Cable Engineers Association
11. IEEE: Applicable requirements and recommended installation practices of IEEE Standards 80, 81, 141 and 142 pertaining to grounding and bonding of systems, circuits and equipment.
12. IEEE-802.11 a, b, g, n: Wireless Local Area Networks
13. IEEE-802.3: 10Mb/s, 100Mb/s, 1Gb/s, and 10Gb/s Ethernet Standards as applicable based on media types (twisted pair copper, fiber optics, etc.)
14. IEEE-802.3af: Power-over-Ethernet (PoE).
15. IEEE-1100-1999: Recommended Practice for Powering and Grounding Sensitive Electronic Equipment.
16. IEEE-141: Comply with applicable requirements for installation of cable tray systems.
17. IEEE-241: Recommended Practice for Electric Power Systems in Commercial Buildings.
18. IFC: International Fire Code
19. ISO/IEC 11801: International Standard on Information Technology – Generic Cabling of Customer Premises.
20. NEC: Applicable local electrical code requirements of the authority having jurisdiction, and the NEC as applicable to electrical boxes and fittings, cable tray systems, and grounding and bonding, pertaining to systems, circuits and equipment.
21. NESC: National Electrical Safety Code
22. NEMA: Applicable requirements of NEMA Stds/Pub No.'s OS1, OS2 and PUB 250 pertaining to raceways, outlet and device boxes, covers, and box supports.
23. NEMA: NEMA Stds/Pub No. VE 1 "Cable Tray Systems"
24. NFPA-70/NEC: National Electrical Code.
25. NFPA-70B: "Recommended Practice for Electrical Equipment Maintenance" pertaining to installation of cable tray systems.
26. NFPA-72: National Fire Alarm and Signaling Code
27. UL Compliance: Applicable requirements of UL 50, UL 514-series, and UL 886 pertaining to electrical boxes and fittings.

28. UL Compliance: Applicable requirements of UL Standards No.'s 467, Electrical Grounding and Bonding Equipment", and 869 "Electrical Service Equipment", pertaining to grounding and bonding of systems, circuits and equipment. In addition, comply with UL Std 486A, "Wire Connectors and soldering Lugs for Use with Copper Conductors." Provide grounding and bonding products which are UL-listed and labeled for their intended usage.
29. University Design and Construction Standards (Architectural, MEP Systems, Structural, and Technology)

B. Where there is a conflict between the code and the contract documents, the code shall have precedence only when it is more stringent than the contract documents. Items that are allowed by the code but are less stringent than those specified on the contract shall not be substituted.

1.7 PROJECT CONDITIONS

A. Prior to submitting a proposal, the Contractor shall inspect the Contract Documents, and shall become fully informed as to laws, ordinances, and regulations affecting the project. The Contractor shall immediately bring to the Owner, Architect, and Engineer's attention, in writing, any existing condition or statute that contradicts, is in conflict with, or negates the Contract Documents. Failure of the Contractor to become fully informed as to all above mentioned items shall in no way relieve the Contractor from any obligations with respect to its proposal.

B. The Technology Documents and/or RFP schematically depict locations of major equipment and components. Field conditions and coordination with related trades may warrant relocations of field devices. No additional compensation will be allowed due to these revisions.

C. System components and equipment shall be rated for the environments where installed.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Equipment and components shall be delivered in factory-fabricated containers or wrappings, which properly protect equipment from damage.

B. Equipment and components shall be handled carefully to prevent damage including but not limited to breakage, denting or scoring of surfaces, etc. Do not install damaged units or components; replace with new. Replace damaged units or components following installation with new ones.

C. Equipment and components shall be stored in original packaging in a dry, clean, well-ventilated space, and shall be protected from construction traffic, weather, moisture, soiling, humidity, and extreme temperatures.

1.9 SEQUENCING AND HANDLING

A. All work shall be reviewed and coordinated with the Owner and CM or GC prior to commencing.

B. DAS, infrastructure, and equipment are sensitive to environmental conditions including but not limited to temperature, dirt, dust, and water. The contractor shall ensure the storage and installation of all system components are sequenced and scheduled accordingly to prevent any damage, loss of performance, and warranty voiding. All mis-installed components shall be replaced with new parts and re-installed at the contractors' expense.

C. Installation shall be coordinated with Structural, Electrical, HVAC, Plumbing, Fire Protection, and other trades to eliminate disruption and/or conflict with other systems.

D. Installation of DAS and infrastructure shall be sequenced with other work to minimize possible damage and soiling during the remainder of construction.

1.10 COORDINATION

The Contractor shall:

A. Coordinate Work of this Section with the requirements of each wireless service provider.

B. Coordinate layout and installation of DAS equipment, antennas, and radiating cable with other construction that penetrates ceilings or is supported by them, including but not limited to light fixtures, HVAC equipment, fire-suppression-system components, and partition assemblies.

C. Coordinate location of cabling and antennas with other trades.

D. Coordinate location of equipment in the communications rooms and spaces with the Owner and Architect.

1.11 WARRANTY

A. Awarded Cellular DAS Vendor will own, operate and maintain Cellular DAS, thus be responsible for any warranty requirements to keep the DAS operational per their contract with Venue Owner / Operator and the Cellular Carriers.

B. Awarded ERRS and FRS Vendor will provide each respective system but turn over to Owner to maintain and operate, thus all ERRS and FRS warranty requirements shall comply with Division 1 and as noted in this Section. Any conflicts shall meet the most stringent required unless approved otherwise by Owner.

C. Warranty periods shall be provided on the components noted below and as listed within this section. Contractor shall include in bid / RFP response all standard manufacturer product warranty information, including warranty length for each major component, including but not limited to passive devices (antennas, splitters, couplers, etc.), cabling (coaxial, fiber, and power), active components (remote radios, head-end equipment, etc.) and power supplies (power plants, rectifiers, batteries, etc.).

D. A warranty on the Work shall be provided by the Contractor. If, within warranty time period after the date of final acceptance by Owner of the installation or within such longer period of time as may be prescribed by law or by the terms of any applicable special warranty required by the Contract Documents or provided by a manufacturer, any of the work or equipment is found to be defective or not in accordance with the Contract Documents, the Contractor shall correct it promptly including all parts and labor after receipt of notice from the Owner to do so unless the Owner has previously given the Contractor a written acceptance of such condition. This obligation shall survive termination of the contract. The Owner shall give such notice promptly after discovery of the condition. Such notice shall be provided by Owner representatives, to be identified, either verbally or in writing. Warranty period shall start based on acceptance by Owner upon completion, testing and acceptance of the installation by the Wireless Carriers.

E. The Structured Cabling Manufacturer shall provide a warranty for all communications cable infrastructure components. This warranty shall cover all components including cable, terminations, patch panels, and wiring panels, etc. to maintain the specified performance and physical criteria. Any such components, link, or channel shall be replaced by the Manufacturer at no cost to Owner during this period. The Contractor and Manufacturer shall submit all information and documentation on Warranty.

F. Nothing contained in the Contract Documents shall be construed to establish a shorter period of limitation with respect to any other obligation which the Contractor might have under the Contract Documents or any manufacturer's warranty. The establishment of the warranty time period after the date of final acceptance or such longer period of time as may be prescribed by law or by the terms of any warranty required by the Contract Documents relates only to the specific obligation of the Contractor to correct the work or equipment, and has no relationship to the time within which their obligation to comply with the Contract Documents may be sought to be enforced, nor to the time within which proceedings may be commenced to establish the Contractor's liability with respect to their obligations other than specifically to correct the work or equipment. Warranty period shall start based on acceptance by Owner upon completion, testing and acceptance of the installation by the Wireless Carriers.

G. If system operation is not fully restored during the warranty period within 24-hours, the Owner reserves the right to require the Contractor to provide on-site manufacturer's service technicians at no additional cost.

H. Special warranty specified in this Specification shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

1. Special Warranty for DAS and Components: There shall be a written warranty, signed by the Manufacturer and Contractor agreeing to correct system deficiencies and replace components that fail in materials or workmanship within a specified warranty period when installed and used according to manufacturer's written instructions. This warranty shall be in addition to, and not limiting, other rights Owner may have under other provisions of the Contract Documents.
2. Contractor shall guarantee coverage and fix any coverage gaps or incorrect signal strengths at no cost to the Owner. The Owner will not accept the system at turn-over until the system has been field tested, verified, certified, and guaranteed that coverage limits have been fulfilled.

1.12 BID INFORMATION

A. Instructions to Bidders

1. The following is a partial list of instructions. Bidders shall provide a complete proposal including all information requested in the RFP Document and this specification.
2. Any questions or misunderstanding should be submitted in writing with the bid.
3. Copies of the bid proposal shall be submitted to the Owner, Architect / Engineer and/or Construction Manager as directed by RFP Document for review and approval.

B. Compliance

1. Bidders shall submit a Statement of Qualifications with their bid proposal that shall include the following information:

    a. Company name, address, telephone number and contact person.
    b. Brief company history.

        1) Years in business.
        2) Number of employees.
        3) Location of Headquarters and branch offices, including international locations.

    c. Resumes of key personnel.
    d. Local staffing description (job descriptions and numbers of persons in each position).
    e. Local service capabilities (hours of operation and parts availability).
    f. Technician factory certifications.
    g. Description of local engineering and project management capabilities.
    h. Line sheet listing major suppliers of security equipment.
    i. Annual dollar value of sales, installation and service of each product line carried.
    j. List of all projects and references for all projects completed in the last five years, including a brief project description, location, construction cost, and completion date.
    k. List of references describing five (5) completed projects of similar size and complexity, including names and telephone numbers of the contact persons.
    l. List of references describing similar projects completed in the area and in the last year including names and telephone number of the customer's contact person.
    m. List of similar projects currently under construction in the area including names and telephone numbers of the customer's contact person.
    n. Licensing information.

2. Additionally, bidders shall submit the following information with their bid proposal:

    a. Manufacturer's literature sheets for all standard manufactured items included in the equipment list and as proposed in the Voluntary Alternate Bid form, if applicable.
    b. Workload and capability statements. The statements shall detail projects that will be active during the completion of this project, and the manpower that would be available for this project.
    c. Confidentiality and return statements. The statements shall guarantee that the Contract Documents shall not be copied or distributed physically or verbally. The Contractor shall also assure the Owner that the Contract Documents shall be returned in their entirety upon request. The successful Contractor will be provided with as many copies as requested.

C. Specification Response

1. The Bid Response Documents shall provide an overview and narrative description of the system architecture including but not limited to topology, application point of interfaces, backbone infrastructure, horizontal infrastructure, cables, terminals, amplifiers, repeaters, media converters, taps, splitters, and antennas.
2. The Bid Response Documents shall include all Service Agreements, Warranties, and Guarantees.

3. The Bid Response Documents shall include an implementation schedule and project timelines starting from Contract Procurement to System Turn-Over.
4. The Bid Response Documents shall include expected annual maintenance costs, consisting of:

    a. Annual maintenance cost beyond expiration of warranty.
    b. Annual maintenance for any items required outside of warranty.
    c. Annual maintenance for each year up to 5-years following the warranty period.

5. The Bid Documents shall include completion of Appendix-A: Additional Bidder Questions
6. The Bid Document shall include completion of Appendix-B: Bidder's DAS Design Assumptions

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, products and solution shall be provided by one of the following DAS Manufacturers:

1. Commscope/Andrew
2. Corning/Mobile Access
3. Solid Technologies
4. TEKO
5. Approved Equal. Refer to 2.11 Alternates for additional requirements.

2.2 DISTRIBUTED ANTENNA SYSTEM (DAS)

A. General Requirements:

1. The Commercial / Cellular DAS shall be a neutral-host, carrier grade, carrier approved DAS that meets the most current Cellular Carrier requirements for coverage and capacity. Additionally, DAS shall meet or exceed current league and/or sports venue industry standards from a wireless coverage and capacity standpoint, including latest fan facing bandwidth recommendations for both upload and download speeds to mobile devices.
2. The Emergency Responder Radio Systems (ERRS) shall provide handheld 2-way radio coverage and capacity to first responders for all applicable authorities and required frequencies as indicated in the RFP and coordinated with the Owner and Architect / Engineer. The ERRS proposed design shall be reviewed with AHJ to ensure compliance with all local adopted code requirements including, but not limited to, IFC and NFPA.
3. The Facility Radio Systems (FRS) shall provide handheld 2-way radio coverage and capacity for all applicable user groups and required frequencies as indicated in the RFP and coordinated with the Owner and Architect / Engineer.

B. System Components:

1. This is a performance based specification thus Contractor and/or their designated RF design engineer shall propose full system design including but not limited to all passive and active devices such as antennas, coaxial and fiber optic cabling, jumpers, splitters, taps, couplers, filters, combiners, remote units, radio heads, and head-end components. If full RF design is not submitted with RFP response, Contractor shall at a minimum include high level concept design including proposed zone / sector count with proposed OEM cutsheets.
2. Contractor and/or their designated power design engineer shall propose full system design including but not limited to power supplies, chassis, cabling, terminals, rectifiers, battery back-up, grounding, etc. If full power design is not submitted with RFP response, Contractor shall at a minimum include high level concept design including proposed power supply rack locations with proposed OEM cutsheets.

C. Management and Monitoring System:

1. The DAS shall be installed with Management and Monitoring System.
2. The Management and Monitoring System shall provide for interactive interfaces to all major DAS electronic and passive components including base head-end, remote units, antenna points, and power supplies.
3. The Management and Monitoring System shall allow for real-time remote management and monitoring of the DAS from an Operator's computer workstation.

2.3 MECHANICAL, ELECTRICAL AND PLUMBING SUPPORT SYSTEMS

A. General

1. Contractor shall provide full fit-out of MEP support systems required to support DAS at Equipment Rooms and throughout Facility.

    a. DAS head-end room is currently a shell space or included in base design as an "add alternate" from a cost perspective. Full cost to provide DAS head-end room fit-out including, but not limited to MEP support systems and architectural modifications (i.e. door, wall, floor, ceiling, sub-roof, etc.) is the responsibility of the DAS provider.
    b. Intermediate TRs will have MEPT support systems provided by base project but any system capacity additions (power, HVAC, etc.) will be the responsibility of the DAS provider.

2. Contractor shall provide all necessary MEPT support systems to maintain appropriate DAS operation and performance as determined by DAS Manufacturer.

B. Mechanical Systems

1. Contractor shall provide all necessary HVAC systems including air-conditioning at head-end equipment room and any supplemental systems or increased system capacity (if required) at MTR, TRs, and any other equipment locations.

C. Electrical Systems

1. Contractor shall provide all necessary Power Distribution including generator, panel boards, feeders, circuits, and receptacles to connect DAS and associated MEPT support systems necessary and provided as part of this. Contractor shall coordinate such requirements with Owner and Architect to confirm spare capacity of any existing systems as well as upgrades or replacement being developed for base building project.
2. Contractor shall provide sub-meters for power panels in head-end room for general DAS head-end equipment, room MEPT support systems and for each Cellular Carrier.
3. Contractor shall provide UPS equipment to maintain uptime of DAS system during failover from normal power to generator power. This includes head-end, remote equipment, power supplies, and any other DAS equipment requiring uninterrupted power.
4. Contractor shall provide any other Electrical Systems that may be required to support DAS, including but not limited to AC power circuits, low voltage DC or digital power to serve remote units and/or head-end equipment.

D. Plumbing Systems

1. Contractor shall provide all necessary pre-action and/or dry agent chemical (such as FM200) Fire Suppression at DAS equipment locations as determined by Owner, AHJ, Emergency Responders, and Cellular Carriers.
2. Contractor shall provide any other Plumbing Systems that may be required to support DAS.

E. Technology Systems

1. Contractor shall provide all necessary raceways for DAS including backbone, antenna, and power cabling.
2. Contractor shall provide all necessary Structured Cabling Systems for DAS including optical fiber backbone, hybrid fiber/power distribution, and antenna cables.
3. Contractor shall provide any other Technology Systems that may be required to support DAS.

2.4 ALTERNATES

A. Contractor Proposed Alternatives

1. The Contractor may propose alternatives for Owner consideration.
2. All alternatives shall include pricing, description, equipment cut-sheets and any other technical documentation necessary.

PART 3 - EXECUTION

3.1 EXAMINATION

The following examination tasks shall be performed by Contractor:

A. Examine pathway elements intended for cable. Check raceways, cables trays, and other elements for compliance with space allocations, installation tolerances, hazards to cable installation, and other conditions affecting installation.

B. Examine walls, floors, roofs, equipment bases, and roof supports for suitable conditions where equipment is to be installed.

C. Provide detailed site survey to determine best cable routing and location of antennas.

3.2 SYSTEM DESIGN CRITERIA

A. General:

1. The DAS, ERRS, and FRS shall distribute and support the following, respectively:

    a. All current technologies available to existing cellular wireless providers authorized to provide service in the United States in all frequency bands.
    b. All current emergency responders' two-way radio communications including First Responders, Police, Fire, Ambulance, and other emergency systems utilized by Public Authorities and Agencies.
    c. All building operations two-way radio systems and other in-house two-way radio communication systems.

2. The system must enable service providers to distribute signal uniformly to all locations within the venue in a manner that mitigates interference to their outside network.
3. The coverage inside the building (in all designated areas) shall provide dominant signal to overcome other signals from other zones or sectors within the building and from outside the building by at least 10dB.
4. The system capacity shall be designed to meet the following minimum upload and download requirements per connected user, based on a 50% "take rate" (i.e. one active / concurrently connected device per seat for 50% of the venue seating capacity.)

    a. Upload = 5 MB/s
    b. Download = 5 MB/s

B. Coverage and Capacity:

1. The DAS shall meet all coverage and capacity requirements for this facility type based on highest occupancy and facility use.
2. The system shall be designed with the appropriate sector/zone capacity and antenna points to ensure acceptable performance. Exact requirements shall be coordinated by the Contractor with Owner and all Service Providers including but not limited to Cellular Carriers, Emergency Responders, and Facility Radio Systems.
3. Interference with other wireless systems: Considerations shall be provided for minimizing interference from other susceptible systems including but not limited to the items noted below. Coordinate with Owner's RF Strategy and Frequency Assignment plans.

    a. Assisted Listening Devices
    b. Bluetooth Devices
    c. FM Radio Transmitter
    d. Media (Radio / TV) Broadcast and/or Intercoms
    e. Specialty Event Wireless
    f. Wireless Broadcast
    g. Wireless Microphones
    h. Wireless Telephone Headsets

3.3 INSTALLATION

A. General:

1. This Section describes the installation locations for the products and materials, as well as methods associated with the DAS and wireless installation portions of the Project. These Specifications, along with the drawings shall be followed during the course of the installation.
2. The Contractor shall examine areas and conditions under which DAS infrastructure is to be installed. Notify Owner, Architect, and Engineer in writing of conditions detrimental to proper completion of the work. Do not proceed with work until unsatisfactory conditions have been corrected in a manner acceptable to the installer.
3. The Contractor shall be knowledgeable of work to be performed by other trades and take necessary steps to integrate and coordinate their work with other trades.
4. The Contractor shall verify space requirements and locations before starting cable installations and terminations. Inappropriate conditions shall be immediately reported to Construction Manager, Owner, Architect, and Engineer prior to initiating installation.
5. All DAS and communications infrastructure shall be installed in an aesthetically pleasing fashion. All surface raceway in new buildings must be approved by the Owner, Architect, and/or Engineer.
6. All communications infrastructure shall be installed for optimal performance.
7. All DAS and communications infrastructure shall be installed to allow for easy additions, moves, and other changes in the future.
8. Final labeling scheme for all DAS and communications components shall be coordinated with the Owner and Engineer during the shop drawings process, prior to initiating work. Labeling scheme shall include but not be limited to communications rooms, cabinets, racks, cable terminal blocks and patch panels, antennas, outlets, cables, etc.
9. Construction within Telecom Rooms must be substantially complete before the installation of the DAS and communications cabling. This includes, but is not limited to, the installation of plywood backboard, cable tray or ladder rack, electrical outlets, light fixtures, sprinklers and ductwork. All walls shall also be painted before the installation.
10. The Contractor is required to coordinate their efforts with the other trades and sub-contractor who may be working within the same vicinity to avoid conflict and lost time.
11. The Contractor shall supply all necessary tools, equipment, accessories, safety equipment, protective clothing, etc., as customary for the craft and necessary for the installation.
12. The contractor shall not install any component in a manner or condition that will void manufacturer and/or contractor warranty. Any such conditions that prevent an acceptable install shall be immediately reported to Construction Manager or General Contractor, Owner, Architect, and Engineer prior to initiating installation. All mis-installed components will be removed and replaced with new, appropriate components at the Contractor’s expense. No additional cost will be submitted to Owner.
13. All equipment shall be installed in a neat and workmanlike manner, arranged for convenient operation, testing and future maintenance.

B. Raceway Installation:

1. Contractor shall comply with all industry codes and standards for DAS raceway installation, including but not limited to, appropriate conduit size, fill ratio, bend radii, number of bends and/or distance between pull-boxes, etc.
2. Fire seal all raceway penetration and openings to maintain fire rating after communications cables are installed.
3. Provide labels on all communications pull-boxes and junction-boxes.

4. Identify conduits at cable tray end by architectural room number.

C. Cable Installation: The following procedures shall apply to cable installation:

1. All distribution cable, backbone cable, horizontal cable, radiating cable, and antenna cable must be plenum rated.
2. All DAS and communications cables routed within Telecom Rooms shall be bundled and combed to provide a neat and organized appearance, per industry standards.
3. Install cables concealed in accessible ceilings. Install cables according to manufacturer's recommended installation practices using approved hangers at a maximum spacing of every 48-inches (1.2m).
4. Cable bends shall not be less than that recommended by the manufacturer of the cable. Do not exceed manufacturer's minimum bending radii and other cable requirements.
5. The contractor shall not install any cable in conduits that does not have the appropriate protect bushings on conduit ends.
6. Do not install bruised, kinked, scored, deformed, or abraded cable. Remove and discard cable if damaged during installation and replace it with new cable.
7. Any exposed cables shall be installed parallel to building lines. Follow surface contours and support the cable according to manufacturer's written instructions. Do not run adjacent and parallel to power or data cables. All exposed cable routing shall be coordinated with the Architect prior to installation.
8. Care shall be taken so as not to damage cable during the installation process and that the manufacturer's and industry standard's pull tension specification is not exceeded.

D. Antenna Installation: The following procedures shall apply to antenna installation:

1. All antennas and associated locations shall be discreet. Antennas shall be concealed wherever possible using stealth technology to ensure installation maintains high architectural form critical to the high-end finish of this project.
2. All antenna locations shall be coordinated with Architect prior to initiating any work.
3. Install antennas per manufacturer's requirements.
4. Contractor shall install antennas with all necessary supports to ensure safe installation and support to prevent falling.
5. Antennas shall be rated accordingly and as applicable for the installation type, location, condition, and application supported.

E. Equipment Installation: The following procedures shall apply to equipment installation:

1. Install surge suppressors where ac-power-operated devices are not protected against voltage transients by integral surge suppressors specified in UL1449. Install surge suppressors at the devices' power-line terminals. Comply with Division 26 Section "Transient Voltage Suppression."
2. Mount electronic equipment in the types of cabinets recommended by manufacturer. Group related items in methodical sequence.
3. Arrange equipment to facilitate access for maintenance and to preserve headroom and passage space.
4. Interface DAS equipment with all base station equipment as required during installation period of DAS.
5. Label all equipment and interfaces.

F. System Management and Monitoring Software Installation: The following procedures shall apply to system management and monitoring software installation:

1. Coordinate computer and data network requirements with Owner's IT Group. This should include MAC and IP addressing, VLAN assignment, bandwidth requirements, class of service (CoS), VPN requirements, etc.
2. The system management and monitoring software shall be fully set up, programmed, and configured.

3.4 COORDINATION

A. Cellular Carrier Coordination: Selected Bidders as determined by Owner shall participate in meetings prior to finalization and award to review qualifications, cost and overall approach. This meeting will be set up by Construction Manager and Owner with selected Bidders.

B. Design Coordination: All components proposed by the Contractor shall be coordinated with the Owner, Architect, and ME Engineers. Provided below is a general list of major items that shall be documented in a table and coordinated. The list provided below is to be used as an example and is not intended to be all inclusive or to limit items required to be reviewed and coordinated.

1. Equipment Type and Physical Size.
2. Rack Units required per location.
3. Electrical Power (voltage, amp, loads, and receptacle types)
4. HVAC (heat dissipation and equipment operating temperature range)
5. Antenna Types and Locations
6. Backbone Distribution (fiber strand allocation)

C. RF and Wireless Coordination:

1. The Contractor shall perform an onsite RF and wireless study prior to finalizing design. This information shall be submitted in hard copy documents.
2. The Contractor shall obtain a copy of the Owner's current RF strategy and frequency assignment. This information shall be reviewed in detail to identify any interfering and/or potentially interfering sources.
3. The Contractor shall review and coordinate the onsite study, Owner's current RF strategy and frequency assignment, and proposed DAS design. The Contractor shall make recommendations to the Owner and adjust the proposed design accordingly to ensure no interfering sources or overlap of frequency assignment.
4. The Contractor shall perform an on-site RF and wireless study after completing system installation. This information shall be submitted in hard copy documents. The results of this test shall be reviewed by the Contractor and Manufacturer to confirm system compliance with coverage, capacity, and performance requirements.

D. Installation Coordination: The Contractor shall field coordinate all work with Construction Manager and other Sub-Contractors and Trades as necessary to minimize conflicts.

E. Schedule: The Contractor shall coordinate the project schedule with the Construction Manager including but not limited to the following:

1. RFP Response
2. RF Design Submittals
3. Construction and Phasing
4. Installation

5. Substantial Completion
6. Final Completion
7. System Acceptance

3.5 IDENTIFICATION

A. The following procedures shall apply to system labeling:

B. General Label Requirements:

1. The labeling scheme shall be provided by the Contractor and coordinated with the Owner and Architect prior to initiating any work. A sample scheme shall be submitted for approval.
2. Label all equipment, components, cables, terminations, enclosures, etc.

3.6 FIELD QUALITY CONTROL

A. Testing, Commission, and Optimization: Contractor shall test, commission and optimize each system upon completion per Cellular Carrier and/or Manufacturer recommendations.

B. Qualitative and Quantitative Performance Tests: Contractor shall verify for each major frequency band utilized that signal coverage area, signal coverage levels, and signal coverage consistency are compliant with Specifications. Testing shall be conducted using calibrated “walk-test” receivers.

C. Test Results: Contractor shall record test results and publish them in electronic and hard copies for distribution to Owner if requested.

3.7 CLEANING

A. Contractor shall clean installed items using methods and materials recommended by manufacturer.

B. Contractor shall clean system components, including antennas and supports, electronic equipment, and distribution components.

3.8 DEMONSTRATION AND TRAINING

A. The following procedures shall apply to demonstration and training:

B. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain equipment for any system (DAS, ERRS, or FRS) that is to be turned over to the Owner to operate and maintain.

1. Train Owner's maintenance personnel on procedures and schedules for system administration, routine use, troubleshooting, servicing, and maintaining equipment.
2. Demonstrate methods of determining optimum alignment and adjustment of components and settings for system controls.
3. Review data in maintenance manuals. Refer to Division 1 Section "Operation and Maintenance Data" or Division 26 Section “General Electrical Requirements.”

4. Schedule training with Owner with at least seven days advance notice.

3.9 RECORD DOCUMENTATION

A. Record documentation shall be submitted to the Owner by the Contractor at the completion of the DAS installation. The contractor shall submit all information necessary to operate and maintain the system including but not limited to the following:

1. As-Built Documents
2. Operations and Maintenance Manuals
3. Maintenance Schedule
4. Maintenance Company Contact Information
5. Troubleshooting Guide
6. Product Data and Manufacturer Cut-Sheets
7. Warranty Information and Contact
8. Manufacturer's Product and Installation Certificate
9. Log (troubleshooting, replacement, expansion, and replacements)
10. Labeling Scheme
11. Spare Parts Lists

B. Contractor shall maintain current record documents at the construction site.

END OF SECTION

APPENDIX A - ADDITIONAL BIDDER QUESTIONS

The following Appendix shall be filled out by each bidder. This information will become contractually part of the prevailing Bidder's agreement.

1. Are you the manufacturer of your proposed solution? If not, who is the manufacturer? Please provide data sheets for all components used in the proposed solution.
2. Detail bands covered by your current offering.
3. Can each service (Cellular, Emergency Responder, Facility Radios) be extended independently or are all services extended together?
4. Provide an overview of the monitoring and maintenance capabilities of the proposed system.
5. Detail the procedure to troubleshoot the following problems:
    a. Disconnected antenna.
    b. Failed remote distribution unit.
    c. Cable break or cut (detail both fiber and coax).
    d. Cable installed is 125% longer than design spec.
6. Provide an overview of the process used in the creation of your proposed design.
7. Detail maintenance and post sale support services, including duration, that are included in the price of the proposed system.
8. Detail maintenance and support services, including duration, that are available for additional cost, including extended warranty options.
9. Define requirements of standard warranty (and any extended warranty) being provided.
10. What extended warranty period is offered beyond standard warranty for the entire, installed system?
11. Do you have regional field service offices? If so, where are they located?
12. What field technical support response time is guaranteed?
13. All services on the proposed system have a guaranteed performance level. Please confirm the performance metrics of your proposed solution and your guarantee to deliver these performance levels as measured by field tests of the installed system or bring the installed system into compliance without cost to Owner.
14. What warranty period is offered for the entire installed system? For the active components? What response time is guaranteed?
15. Define the RF power per RF carrier, band and protocol.
16. Explain how RF output power is measured and where in the system the measurement is taken (i.e. at antenna point, at remote, etc.)
17. When providing system performance metrics, are these measured at the output of the remote unit? Do performance metrics factor in any cable loss?
18. List the system noise figure and how it is defined.
19. Describe cable distances and loss and how it affects your system, or attach a chart w/cable specs and max distances.
20. Please list the waveform accuracy specification for all supported protocols and provide performance test documentation.
21. How does/will your solution support 3G/4G services (HSPA/HSPA+, WiMAX, LTE)?
22. Does your solution support MIMO? If so, please describe how this is achieved in detail.
23. Does your solution support 64QAM data? Please provide test results.
24. Does your system support various power options—AC or DC?
25. Can the solution use UPS systems? If so, how are they alarmed? Describe the various options (duration of support, amount of equipment).
26. Does your solution support SNMP? If so, how is it supported (external box or integrated) and what are the connectivity options (LAN, wireless modem, POTS line)?
27. Do you offer a NOC/NMS capability for centralized monitoring/maintenance? If so, how many systems can be simultaneously monitored and managed?
28. If your system supports multiple frequency bands, can each band be managed independently? Can a frequency band be shut down on a system wide basis? Can a frequency band be shut down at a specific passive antenna point?
29. Can attenuation be applied via software to a single antenna point?

30. Can your solution support capacity and coverage changes post installation? If so, how is this managed?
31. Describe the system architecture flexibility of your solution(s).
32. Can your solution use the existing cable infrastructure in or between buildings? Please describe.
33. What is your MTBF for all products you're responding with?
34. Describe the physical space requirements for main equipment locations based on the system configuration proposed in this RFP.
35. List the potential RF interfaces your system can support (base station, BDA/repeater, CPRI/OBSAI base station interface, etc.).

APPENDIX-B - BIDDER'S DAS DESIGN ASSUMPTIONS

The following Appendix shall be filled out by each bidder. This information will become contractually part of the prevailing Bidders agreement.

1. Define number of sectors per frequency per service provider.
2. Define Design Goal. (example: -85 dBm for 99% of defined coverage area at 90% of time)
3. Define Coverage.
4. Define System Feed. (Will the system be fed remotely (off-air) or from a base station(s) on or off-site)?
5. State the assumed fade margin for the RF coverage prediction and what that accounts for.
6. State what the RF coverage prediction and system designs are based on.
7. State physical mounting locations for main equipment and if all necessary mounting gear is included in the proposal. This should include physical space and environmental requirements.
8. State AC Power and Grounding requirements in proposed equipment rooms.
9. State what types of antennas are permitted and confirm antenna location height from floor.
10. State whether existing cable pathways can be used. Confirm whether installation of additional cable racks or raceways is required.
11. State whether installation of new conduit is required.
12. State whether cable lengths are estimates or not-to-exceed amounts.
13. State whether existing cable infrastructure can be used. If so, state type and existing locations.
14. State whether penetration of fire-rated walls require approved fire-stopping methods.
15. State whether dust tents/partitions, water misting of surfaces, etc., will be required.
16. Confirm if quoted cabling is plenum rated; if required.
17. Confirm if Union labor is quoted.
18. Confirm if special high-lift equipment is quoted.
19. Describe close-out commissioning documentation package.
20. State whether spare products are quoted per Manufacturer's recommended quantities.

SECTION 28 05 00.10 – COMMON WORK RESULTS FOR ELECTRONIC SECURITY

PART 1 - GENERAL

1.1 Description of Work

A. Provide the electronic security system (ESS) in accordance with the drawings, specifications, and referenced publications.

B. Perform all work, products, systems integration, engineering, and design work required for the project in order to ensure complete and fully operational systems and proper installation of equipment. Provide calculations and analysis to support design and engineering decisions as specified in submittals. Provide and pay all labor, materials, and equipment, sales and gross receipts and other taxes. Secure and pay for plan check fees, permits, other fees, and licenses necessary for the execution of work as applicable for the project. Give required notices; comply with codes, ordinances, regulations, and other legal requirements of public authorities, which bear on the performance of work.

C. Provide an ESS, installed, programmed, configured, documented, and tested. The security system includes but is not limited to: access control, intrusion detection, duress alarms, elevator control interface, video surveillance and assessment, video recording and storage, delayed egress, intercommunication system, fire alarm interface, equipment cabinetry, and uninterruptible power supplies (UPS) interface.

D. The work includes the procurement and installation of electrical wire and cables, the installation and testing of all system components. Inspection, testing, demonstration, and acceptance of equipment, software, materials, installation, documentation, and workmanship, shall be as specified herein. Provide all associated installation support, including the provision of primary electrical input power circuits.

E. Provide repair service replacement parts and on-site service during the warranty period. Guarantee all parts and labor for a term of one (1) year, unless dictated otherwise in this specification from the acceptance date of the system as described in specification 280800.10. The Contractor is responsible for all equipment, software, firmware, licensing, shipping, transportation charges, and expenses associated with the service of the system for one (1) year.

F. Operator training is not required.

1.2 Summary

A. This specification provides general requirements for the overall electronic security system (ESS) applicable to all projects.

1.3 Related Documents

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. This Specification is the base document for electronic security systems. Use the following specification sections in conjunction to provide a complete and fully integrated security management system.

1. 27 05 26.10 – Grounding and Bonding for Security Systems
2. 27 05 28.10 – Pathways for Security Systems
3. 27 05 36.10 – Cable Trays for Security Systems
4. 27 05 44.10 – Sleeves and Sleeve Seals for Security Pathways and Cabling
5. 27 11 16.10 – Security Cabinets, Racks, Frames, and Enclosures
6. 27 13 00.10 – Security Backbone Cabling
7. 27 15 00.10 – Security Horizontal Cabling
8. 28 05 00.10 – Common Work Results for Electronic Security
9. 28 05 07.10 – Power Sources for Electronic Security
10. 28 05 09.10– Surge Protection for Electronic Security
11. 28 05 13.10 – Servers, Workstations, and Storage for Electronic Security
12. 28 05 31.10 – Communications Equipment for Electronic Security
13. 28 08 00.10 – Commissioning of Electronic Security
14. 28 10 00 – Access Control
15. 28 15 15 – Electrified Locking Devices & Accessories
16. 28 15 23 – Intercom Entry Systems
17. 28 15 25 – Electronic Key Management Systems
18. 28 15 27 – Access Control Electronic Turnstiles & Mobility Systems
19. 28 18 00 – Security Access Detection Equipment
20. 28 19 15 – Perimeter Vehicle Access Management Systems
21. 28 20 00 – Video
22. 28 31 00 – Intrusion Detection
23. 28 49 17 – Electronic Personal Safety Emergency Aid Devices
24. 28 51 19 – Control Room and Monitoring Equipment
25. 32 31 11 – Gate Operators

C. Requirements of Specification 280800.10 take precedence over Division 01 System Acceptance requirements.

D. Related Sections include the following:

1. Division 01

2. Division 08

    a. Coordinate Division 8 and 28 requirements.

3. Division 12

    a. Coordinate case mounted security sensors and equipment.

4. Division 14

    a. Elevator Contractor shall coordinate and install equipment in the elevator. The equipment includes the intercoms, cameras, and card readers.
    b. Terminate signal lines in the elevator machine room for use by the Security Contractor.
    c. Security Contractor shall coordinate cabling. Use High Flex cables for elevator installations listed for intended purpose.

d. The Security Contractor shall provide terminal strips and wire from the security panel, labeling each point and its respective function (input output) for the Elevator Contractor shall provide final termination from elevator panel.
e. Provide a transition box for all security related equipment.

5. Division 23

a. Coordinate installation of the Light Control Equipment, Radio, and Elevator Status Equipment installed in the Security Monitoring Console. Provide dedicated Liebert Cooling Systems (or approved equivalent) and controls, for each Security Monitoring Control and Equipment room.

6. Division 26

a. Provide dedicated Emergency Electrical Power (120 VAC) circuits as required to provide full system functionality.

1.4 References

A. American National Standards Institute (ANSI)

1. ANSI INCITS 92, Data Encryption Standard
2. ANSI/TIA-568.0-D, Generic Telecommunications Cabling for Customer Premises
3. ANSI/TIA-568.1-D, Commercial Building Telecommunications Infrastructure Standard
4. ANSI/TIA-568-C.2, Latest Edition, Balanced Twisted-Pair Telecommunications Cabling And Components Standards
5. ANSI/TIA-568-C.3, Rev C (6/2008+A1:10/2011), Optical Fiber Cabling Components Standard
6. ANSI/TIA-568-C.4, Latest Edition, Broadband Coaxial Cabling and Components Standard
7. ANSI/TIA-569, REV D (4/2015), Telecommunications Pathways and Spaces
8. ANSI/TIA-606, Latest Edition, Administration Standard for the Telecommunications Infrastructure
9. ANSI/TIA-607, Latest Edition, Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises
10. ANSI/TIA/EIA 492AAAB, Detail Specification for 50µm Core Diameter / 125µm Cladding Diameter Class Ia Graded-Index Multimode Optical Fibers.
11. ANSI/TIA/EIA-526-14 Revision C (4/2015), Optical Power Loss Measurement of Installed Multimode Fiber Cable Plant; Modification of IEC 61280-4-1 edition 2, Fiber-Optic Communications Subsystem Test Procedures- Part 4-1: Installed Cable Plant-Multimode Attenuation Measurement
12. ANSI/SIA CP-01-2014, Control Panel Standard - Features for False Alarm Reduction

B. ASTM International (ASTM)

1. ASTM A153/A153M-16, Standard Specifications for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
2. ASTM B3-13, Standard Specification for Soft or Annealed Copper Wire
3. ASTM B32-08, Standard Specification for Solder Metal
4. ASTM C1107/C1107M-14a, Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)
5. ASTM D709-16, Standard Specification for Laminated Thermosetting Materials

6. ASTM E84-16, Standard Test Method for Surface Burning Characteristics of Building Materials

C. Federal Information Processing Standards (FIPS):

1. FIPS PUB 201 Latest Edition, Personal Identity Verification (PIV) of Federal Employees and Contractors

D. Institute of Electrical and Electronics Engineers (IEEE)

1. IEEE Std 100, The Authoritative Dictionary of IEEE Standards Terms
2. IEEE 81, Latest Edition, Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System
3. IEEE 142, Latest Edition, Recommended Practice for Grounding of Industrial and Commercial Power Systems - IEEE Green Book (Color Book Series)
4. IEEE C2 National Electrical Safety Code (NESC), 2017 Edition
5. IEEE C62.41.1, Latest Edition, Guide on Surges Environment in Low Voltage (1000 V and Less) AC Power Circuits
6. IEEE C62.41.2, , Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and Less) AC Power Circuits

E. International Organization for Standardization (ISO)

1. ISO 7810, Latest Edition, A2, Identification Cards – Physical Characteristics

F. National Electrical Contractors Association (NECA)

1. NECA 1 Latest Edition, Standard for Good Workmanship in Electrical Construction

G. National Electrical Manufacturers Association (NEMA)

1. NEMA 250, Latest Edition, Enclosures for Electrical Equipment (1000 Volts Maximum)
2. NEMA ICS 1 Latest Edition, Industrial Control and Systems: General Requirements
3. NEMA ICS 2 Latest Edition, Industrial Control and Systems: Controllers, Contractors, and Overload Relays Rated 600 Volts
4. NEMA ICS 6 Latest Edition, Industrial Control and Systems: Enclosures

H. National Fire Protection Association (NFPA)

1. NFPA 70 Latest Edition, National Electrical Code
2. NFPA 72 Project Edition, National Fire Alarm and Signaling Code.
3. NFPA 101 Project Edition, Life Safety Code
4. NFPA 262, Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces
5. NFPA 730 Latest Edition, Guide for Premises Security
6. NFPA 731 Latest Edition, Standard for the Installation of Electronic Premises Security Systems

I. National Institute of Standards and Technology (NIST)

1. PIV Card Specifications:

a. SP 800-73-2, Interfaces for Personal Identity Verification

b. NISTIR 7284, Personal Identity Verification Card Management Report
c. NISTIR 7284, Personal Identity Verification Card Management Report
d. SP 800-76-2, Biometric Data Specification for Personal Identity Verification
e. SP 800-78-4, Cryptographic Algorithms and Key Sizes for Personal Identity Verification
f. SP 800-73-4, PIV Card Application and Middleware Interface Test Guidelines

2. PIV Card and Middleware Conformance Testing:

a. SP 800-85B, PIV Data Model Conformance Test Guidelines

3. PIV Accreditation:

a. SP 800-96, PIV Card / Reader Interoperability Guidelines

4. Issuing Organizations:

a. SP 800-87 Rev 1, Codes for the Identification of Federal and Federally-Assisted Organizations
b. NISTIR 7337 (2006); Personal Identity Verification Demonstration Summary

J. Security Industry Association (SIA)

1. SIA BIO-01-1993.02 (R2000.06), Biometric Vocabulary Standard
2. SIA DC-01-1988 (R2001.04), DCS Computer Interface (CIS-1) Technical Report
3. SIA DC-03-1990.01 (R2003.10), DCS SIA Format Standard
4. SIA DC-07-2001.04, DCS Computer Interface (CIS-2) Standard

K. Telecommunications Industries Association (TIA)

1. TIA-232 Latest Edition, Interface Between Data Terminal Equipment and Data Circuit - Terminating Equipment Employing Serial Binary data Exchange
2. EIA/ECA-319 Latest Edition, Cabinets, Racks, Panels, and Associated Equipment
3. TIA-455-3, Latest Edition, Procedure to Measure Temperature Cycling Effects on Optical Fibers, Optical Cable, and Other Passive Fiber Optic Components
4. TIA-455, Latest Edition, General Requirements for Standard Test Procedure for Fiber Optic Fibers, Cables, Transducers, Sensors, Connecting and Terminating Devices, and Other Fiber Optic Components
5. TIA-232 Latest Edition, Interface Between Data Terminal Equipment and Data Circuit - Terminating Equipment Employing Serial Binary data Exchange
6. TIA-598 Revision D (7/2014), Optical Fiber Cable Color Coding
7. TIA-604-3 Latest Edition, FOCIS-3 Fiber Optic Connector Intermateability Standard, Type SC and SC-APC
8. TIA-604-1 Latest Edition, Fiber Optic Connector Intermateability Standard

L. Underwriters Laboratories (UL)

1. UL 6 Latest Edition, Electrical Rigid Metal Conduit - Steel
2. UL 50 Latest Edition, Enclosures for Electrical Equipment, Non-Environmental Considerations
3. UL 50E Latest Edition, Enclosures for Electrical Equipment, Environmental Considerations
4. UL 83 Latest Edition, Thermoplastic-Insulated Wires and Cables

5. UL 294 Latest Edition, Access Control System Units
6. UL 444 Latest Edition, Communications Cables
7. UL 464 Latest Edition, Audible Signaling Devices for Fire Alarm and Signaling Systems, including Accessories
8. UL 467 Latest Edition, Standard for Safety Grounding and Bonding Equipment
9. UL 497B Latest Edition, Protectors for Data Communication and Fire Alarm Circuits
10. UL 609 Latest Edition, Local Burglar Alarm Units and Systems
11. UL 634 Latest Edition, Connectors and Switches for Use with Burglar-Alarm Systems
12. UL 636 Latest Edition, Holdup Alarm Units and Systems
13. UL 639 Latest Edition, Intrusion Detection Units
14. UL 681 Latest Edition, Installation and Classification of Burglar and Holdup Alarm Systems
15. UL 796 Latest Edition, Printed-Wiring Boards
16. UL 797 Latest Edition, Electrical Metallic Tubing -- Steel
17. UL 827 Latest Edition, Central Station Alarm Services
18. UL 910 Latest Edition, Test for Flame-Propagation and Smoke-Density Values for Electrical and Optical-Fiber Cables Used in Spaces Transporting Environmental Air
19. UL 969 Latest Edition, Marking and Labeling Systems
20. UL 972 Latest Edition, Burglary Resisting Glazing Material
21. UL 1037 Latest Edition, Antitheft Alarms and Devices
22. UL 1076 Latest Edition, Proprietary Burglar Alarm Units and Systems
23. UL 1424 Latest Edition, Power-Limited Fire-Alarm Circuits
24. UL 1492 Latest Edition, Audio-Video Products and Accessories
25. UL 1581 Latest Edition, Reference Standard for Electrical Wires, Cables, and Flexible Cords
26. UL 1610 Latest Edition, Central-Station Burglar-Alarm Units
27. UL 1635 Latest Edition, Digital Alarm Communicator System Units
28. UL 1638 Latest Edition, Visible Signaling Devices for Fire Alarm and Signaling Systems, including Accessories
29. UL 1638A Latest Edition, Visual Signaling Appliances for General Signaling Use
30. UL 1655 Latest Edition, Community-Antenna Television Cables
31. UL 1660 Latest Edition, Liquid-Tight Flexible Nonmetallic Conduit
32. UL 1666 Latest Edition, Test for Flame Propagation Height of Electrical and Optical-Fiber Cables Installed Vertically in Shafts
33. UL 1981 Latest Edition. Central Station Automation Systems
34. UL 2050 Latest Edition, National Industrial Security Systems
35. UL 2196 Latest Edition, Tests for Fire Resistive Cables

1.5 Definitions

A. ARA: Area of Rescue Assistance

B. Basket Cable Tray: A fabricated structure consisting of wire mesh bottom and side rails.

C. BICSI: Building Industry Consulting Service International

D. Controller: An intelligent peripheral control unit that uses a computer for controlling its operation. Where this term is presented with an initial capital letter, this definition applies.

E. CPU: Central processing unit.

F. Credential: Data assigned to an entity and used to identify that entity.

G. DGP: Data Gathering Panel

H. EMI: Electromagnetic interference.

I. EMT: Electric Metallic Tubing

J. ESS: Electronic Security System

K. GFI: Ground fault interrupter.

L. Identifier: A credential card, keypad personal identification number or code, biometric characteristic, or other unique identification entered as data into the entry-control database for the purpose of identifying an individual. Where this term is presented with an initial capital letter, this definition applies.

M. I/O: Input/Output.

N. INC: Intelligent Network Controller

O. Intrusion Zone (IZ): A space or area for which an intrusion must be detected and uniquely identified, the sensor or group of sensors assigned to perform the detection, and any interface equipment between sensors and communication link to central-station control unit.

P. LAN: Local area network.

Q. LCD: Liquid-crystal display.

R. LED: Light-emitting diode.

S. LOD: Level of Detail

T. LOE: Level of Effort

U. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control and signaling power-limited circuits.

V. M-JPEG: Motion – Joint Photographic Experts Group.

W. MPEG: Moving picture experts group.

X. NEC: National Electric Code

Y. NECA: National Electrical Contractors Association

Z. NEMA: National Electrical Manufacturers Association

AA. NFPA: National Fire Protection Association

BB. NRTL: Nationally Recognized Testing Laboratory.

CC. Open Cabling: Passing telecommunications cabling through open space (e.g., between the studs of a wall cavity).

DD. OPS: Office of Protection Services

EE. OTDR: Optical Time Domain Reflectometer

FF. PACS: Physical Access Control System

GG. PIR: Passive infrared

HH. PIR Rex: Passive Infrared Request to Exit

II. PPSD: Personnel and Physical Security Division (A department within Owner Organization)

JJ. RCDD: Registered Communications Distribution Designer.

KK. RF: Radio frequency.

LL. RFI: Radio-frequency interference.

MM. RIGID: Rigid conduit is galvanized steel tubing, with a tubing wall that is thick enough to allow it to be threaded.

NN. RS-232: An TIA/EIA standard for asynchronous serial data communications between terminal devices. This standard defines a 25-pin connector and certain signal characteristics for interfacing computer equipment.

OO. RS-485: An TIA/EIA standard for multipoint communications.

PP. SMS: Security Management System – A SMS is a software that incorporates multiple security subsystems (e.g., access control, intrusion detection, closed circuit television, intercom) into a single platform and graphical user interface.

QQ. Standard Intruder: A person who weighs 100 lb. (45 kg) or more and whose height is 1525 mm (60 in) or more; dressed in standard clothing.

RR. Standard-Intruder Movement: Any movement, such as walking, running, crawling, rolling, or jumping, of a "standard intruder" in a protected zone.

SS. TCP/IP: Transport control protocol/Internet protocol incorporated into Microsoft Windows.

TT. TDMM: Telecommunications Distribution Methods Manual

UU. TIA: Telecommunications Industry Association

VV. UPS: Uninterruptible Power Supply

WW. UTP: Unshielded Twisted Pair

XX. VASS: Video Assessment and Surveillance System

YY. VPN: Virtual Private Network

ZZ. WAN: Wide Area Network.

AAA. WAV: The digital audio format used in Microsoft Windows.

BBB. Windows: Operating system by Microsoft Corporation.

CCC. Workstation: A PC with software that is configured for specific limited security system functions.

DDD. WYSIWYG: (What You See Is What You Get.) Text and graphics appear on the screen the same as they will print.

1.6 General Arrangement of Contract Documents

A. The Contract Documents supplement to this specification indicates approximate locations of equipment. The installation and/or locations of the equipment and devices shall be governed by the intent of the design; specification and Contract Documents, with due regard to actual site conditions, recommendations, ambient factors affecting the equipment and operations in the vicinity. The Contract Documents are diagrammatic and do not reveal all offsets, bends, elbows, components, materials, and other specific elements that may be required for proper installation. If any departure from the contract documents is deemed necessary, or in the event of conflicts, the submit details of such departures or conflicts in writing to the owner or owner's representative for his or her comment and/or approval before initiating work.

B. Anything called for by one of the Contract Documents and not called for by the others shall be of like effect as if required or called by all, except if a provision clearly designed to negate or alter a provision contained in one or more of the other Contract Documents shall have the intended effect. In the event of conflicts among the Contract Documents, the Contract Documents shall take precedence in the following order: the Form of Agreement; the Supplemental General Conditions; the Special Conditions; the Specifications with attachments; and the drawings.

1.7 Submittals

A. General

1. Comply with the Contract Documents and in accordance with this section. Submittals lacking the breath or depth of these requirements will be considered incomplete and rejected. Submissions are considered multidisciplinary and require coordination with applicable divisions to provide a complete and comprehensive submission package. Additional general provisions are as follows:
   a. Schedule submittals to maintain the project schedule. For coordination drawings refer to Division 1 Specification, which outline basic submittal requirements and coordination.
   b. Identify variations from requirements of Contract Documents and state product and system limitations, which may be detrimental to successful performance of the completed work or system.
   c. Submit each package at one (1) time for each review and include components from applicable disciplines (e.g., electrical work, architectural finishes, door hardware, etc.) which are required to produce an accurate and detailed depiction of the project.
   d. Manufacturer's information used for submittal shall have pages with items for approval tagged, items on pages shall be identified, and capacities and

performance parameters for review shall be clearly marked through use of an arrow or highlighting. Provide space for COTR and Contractor review stamps.

e. Technical Data Drawings shall be in the project specific version of AutoCAD® or REVIT, drawn accurately, and in accordance with Smithsonian Institution CAD and REVIT Standards. FREEHAND SKETCHES OR COPIED VERSIONS OF THE CONSTRUCTION DOCUMENTS WILL NOT BE ACCEPTED. If departures from the technical data drawings are subsequently deemed necessary by the Contractor, submit details of such departures and the reasons thereof in writing to the COTR and the PPSD Security Engineer for approval before initiating work.

f. Submittal Format
   1) Provide one (1) hard-copy of drawings. Make all other submittals as PDF with bookmarks for sections.

B. Pre-Installation Submittal

1. Qualifications

a. Provide Company certifications

1) Genetec
   a) Certified Integrator
   b) Axis
   c) 2N

b. Include qualifications and manufacturer's certifications for individuals working on the project including but not limited to:

1) Genetec (Access Control, Video Management Systems)
2) 2N (Intercom & Public Address)
3) Axis (Cameras)
4) Cisco
   a) CCNA

5) BICSI
   a) RCDD

c. Provide project references as outlined in Paragraph 1.11 A "Contractor Qualifications".

2. Product Data

a. Provide a chart of product data listing the specification section and paragraph number of each product. Annotate if "Provided as Specified" or "Substitution Requested".

b. Product data sheets organized and bookmarked by Specification Division. Annotate deviations from the design documents and the justification for the change.

c. Where the words, "or approved equivalent" or like words are used, either furnish the equipment as specified or submit a request for substitution in writing with the make, model, and justification to the COTR and the PPSD Security Engineer for approval.

d. If the contractor recommends equipment substitution, the contractor is responsible for complete documentation of the reason for the change including price differential

and is financially liable for the design time expended by the security consultant to research the substitution.

3. Shop Drawings

a. Build upon the design documents to reflect current conditions and approved product data. Annotate deviations from the design documents and the justification for the change.
b. Include wiring diagrams to include but not limited to power supplies, card readers, fire alarm connections, elevator interface, and tamper circuits.
c. Security door schedule coordinated with Division 8 requirements. Include the following information:

1) Configuration Number
2) Door Number (Derived from Architectural Drawings)
3) Floor Plan Sheet Number
4) Standard Detail Number
5) Door Description (Derived from Loading Sheets)
6) Security Point Number (Derived from Loading Sheets)
7) Door Position or Monitoring Device Type, Make & Model Number
8) Lock Type, Model Number & Power Input/Draw (standby/active)
9) Card Reader Type, Make & Model Number
10) Shunting Device Type, Make & Model Number
11) Sounder Type, Make & Model Number
12) Camera Make & Model Number
13) Misc. devices as required
    a) Delayed Egress Type, Make & Model Number
    b) Intercom Make & Model Number
    c) Electric Transfer Hinge
    d) Electric Pass-through device

14) Remarks column indicating special notes or door configurations

C. Pre-Programming Submittal

1. IP Addressing Scheme
    a. Provide Owner Security Lead with the quantity of devices requiring IP addresses. Owner Security Lead will then provide the IP addressing scheme.
2. Loading Sheets
    a. Provide loading sheets for each DGP, including input and output boards for all field panels associated with the project.
    b. OPS-PPSD will provide blank electronic sheets for contractor use.
    c. Provide a spreadsheet for each DGP. Name the spreadsheet with the DGP number (e.g. “Site Name DGP-01.xls”)

D. Pre-Acceptance Testing

1. OPS-PPSD will provide blank testing forms for contractor to reproduce and fill out during testing.
2. Contractor Field Test
    a. Contractor performs the Contractor Field Test (CFT) of all devices utilizing Owner Security Lead provided forms and submits test results to Owner.
3. Performance Verification Test

a. Based on the Owner approval of the Contractor's Field Test, the COTR will schedule the PVT with the Contractor and Owner.
b. Owner will witness the Contractor conduct the PVT of all devices utilizing the same form as for the CFT.

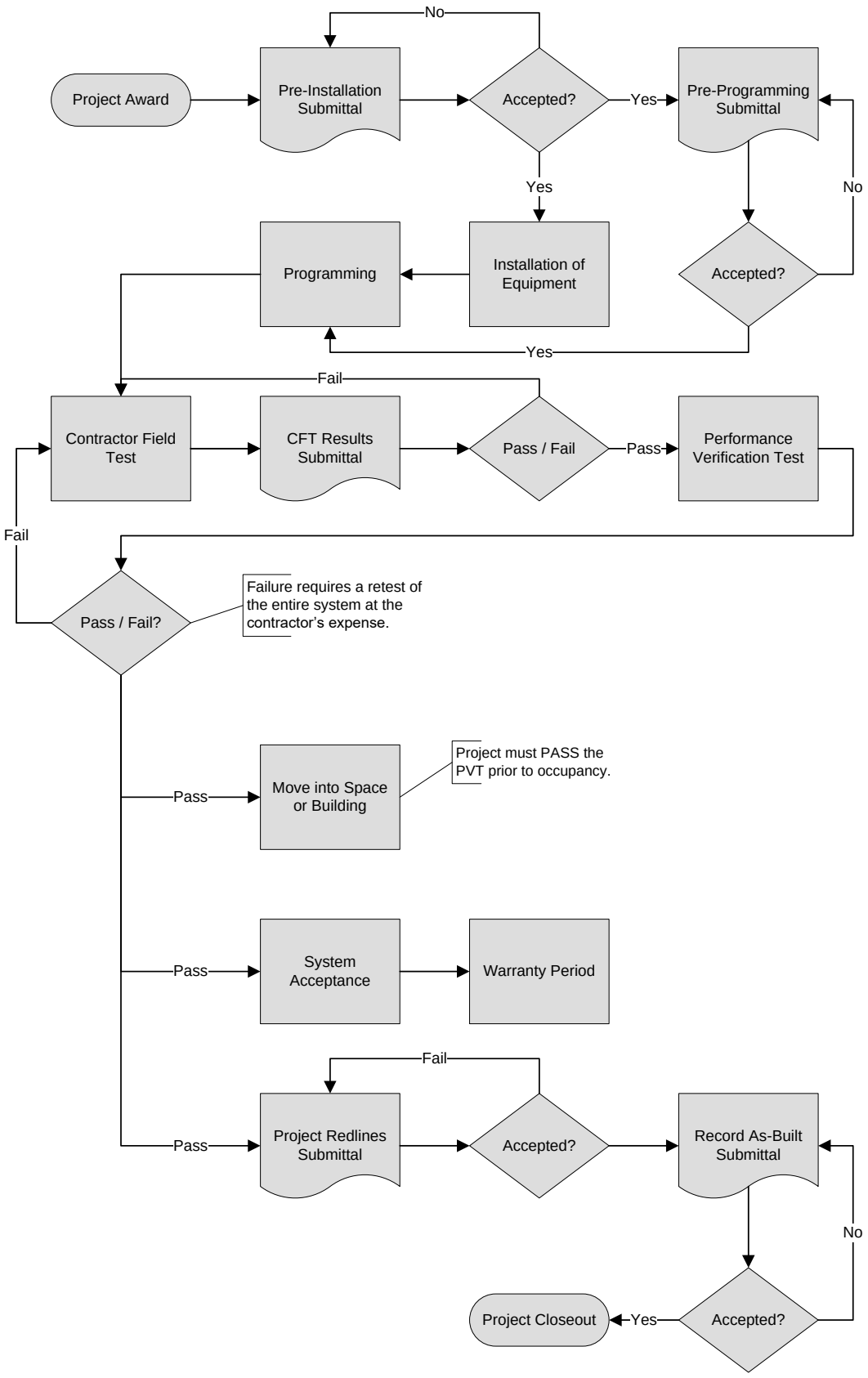
E. Closeout Submittals

1. Project Redlines
   a. Neatly maintain an up-to-date set of construction redlines detailing current location and configuration of the project components.
   b. Mark the redline documents with the words 'Master Redlines' on the cover sheet and be maintained by the Contractor in the project office.
   c. Field drawings shall be used for data gathering & field changes. These changes shall be made to the master redline documents daily. Field drawings shall not be considered "master redlines".
   d. Provide access to redline documents anytime during the project for review and inspection by the COTR or authorized Owner Security Lead representative.
   e. Any project component or assembly that is not installed in strict accordance with the drawings shall be noted on the drawings.
   f. Submit the Master Redline document to the COTR and Owner Security Engineer for review and approval of all changes or modifications to the documents prior to producing Record Construction Documents. The COTR shall be given a minimum of a thirty (30) day review period to determine the adequacy of the Master Redlines. If the master redlines are found suitable by the COTR and the PPSD Security Engineer, the COTR will initial and date each sheet and turn the redlines over to the Contractor for Record As-Built development.
2. Record Construction Documents (Record As-Built)
   a. The submitted as built documents shall be in editable electronic formats and the ownership of the drawings shall be fully relinquished to the owner.

1.8 Project Process Diagram

A. The ESS Project Process Diagram (below) is provided to identify key consecutive or concurrent tasks and milestones required to ensure the project is completed prior to owner occupancy. Substantial completion means all systems have been fully tested and accepted in writing by OPS. Minor or non-life safety related punch list items may continue through owner occupancy, but shall be resolved within two (2) weeks of official date of occupancy.

B. The contractor is encouraged to utilize the diagram for the development of project schedules, and coordinating submissions.


No
Project Award
Pre-Installation Submittal
Accepted?
Yes
Pre-Programming Submittal
Yes
No
Programming
Installation of Equipment
Accepted?
Yes
Fail
Contractor Field Test
CFT Results Submittal
Pass / Fail
Pass
Performance Verification Test
Fail
Pass / Fail?
Failure requires a retest of the entire system at the contractor's expense.
Pass
Move into Space or Building
Project must PASS the PVT prior to occupancy.
Pass
System Acceptance
Warranty Period
Fail
Pass
Project Redlines Submittal
Accepted?
Record As-Built Submittal
No
Project Closeout
Yes
Accepted?

1.9 Coordination

A. Coordinate arrangement, mounting, and support of electronic security equipment:

B. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.

C. To provide for ease of disconnecting the equipment with minimum interference to other installations.

D. To allow right of way for piping and conduit installed at required heights.

E. Ensure raceways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.

F. Coordinate the installation of required supporting discipline devices placement and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

G. Coordinate the locations of access panels and doors for electronic security items that are behind finished surfaces or otherwise concealed. Access doors and panels are specified in Division 08 Section "Access Doors and Frames."

H. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."."

1.10 Quality Assurance

A. Contractor Qualifications

1. The Contractor or security sub-contractor shall be a licensed security Contractor with a minimum of five (5) years' experience installing and servicing systems of similar scope and complexity. The Contractor shall be an authorized regional representative of the electronic security systems included in the project scope.
2. Provide four (4) current references from clients with systems of similar scope and complexity which became operational in the past three (3) years. At least three (3) of the references shall be utilizing the same system components, in a similar configuration as the proposed system. The references must include a current point of contact, company or agency name, address, telephone number, complete system description, date of completion, and approximate cost of the project.
3. The owner reserves the option to visit the reference sites, with the site owner's permission and representative, to verify the quality of installation and the references' level of satisfaction with the system.
4. Provide copies of system manufacturer certification for all technicians. Only utilize factory-trained technicians to install, program, and service the electronic security systems. The Lead Technician shall have a minimum of five (5) continuous years of technical experience in electronic security systems.
5. The Contractor shall have a local service facility located within 60 miles of the project site. The local facility shall include sufficient spare parts inventory to support the service requirements associated with this contract. The COTR and the Owner Security Engineer reserves the option of visiting the company's facility to verify the service inventory and presence of a local service organization.

6. Refer to Division 27 Specifications for additional requirements for cabling.

B. Electrical Components, Devices, and Accessories

1. Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Material & Workmanship

1. Unless otherwise specifically provided under this contract, all equipment, material and articles to be incorporated in the work shall be new and of the most suitable grade for the purposes intended.
2. References to any equipment, material, article or patented process, by trade name, make or catalog number shall be regarded as establishing a standard of performance and quality, and shall not be construed as limiting competition.
3. When so directed, the Contractor shall submit samples for approval at the Contractor's expense. Equipment, materials, and articles installed or used without the required approval shall be at the Contractors risk of rejection.
4. Warranties of all work and installed products shall be according to the Contract General Provisions.

1.11 Maintenance & Service

A. General Requirements

1. Provide services required and equipment necessary to maintain the electronic security system in an operational state as specified for a period of one (1) year after formal written acceptance of the system.
2. Provide necessary material required for performing scheduled adjustments or other non-scheduled work. Minimize impacts on facility operations when performing scheduled adjustments or other non-scheduled work. See also General Project Requirements.

B. Description of Work

1. The adjustment and repair of the security system includes the following items computers equipment, communications transmission equipment and data transmission media (DTM), local processors, security system sensors, access control equipment, facility interface, signal transmission equipment, intercoms, and video equipment.

C. Personnel:

1. Service personnel shall be certified in the maintenance and repair of the selected type of equipment and qualified to accomplish all work promptly and satisfactorily. Advise the COTR and the Owner Security Engineer in writing of the name of the designated service representative, and of any change in personnel. Provide the COTR and the Owner Security Engineer with copies of system manufacturer certification for the designated service representative.

D. Emergency Service

1. The owner shall initiate service calls whenever the system is not functioning properly. Provide the owner with an emergency service center telephone number. Staff the emergency service center 24 hours a day 365 days a year.
2. The Smithsonian Institution has sole authority for determining catastrophic and non-catastrophic system failures.
3. Catastrophic system failures are defined as any system failure that the Owner determines will place the facility(s) at increased risk. For catastrophic system failures, provide same day four (4) hour service response with a defect correction time not to exceed eight (8) hours from notification.
4. For non-catastrophic failures, provide eight (8) hour service response with a defect correction time not to exceed 24 hours from notification.

E. Work Request

1. Separately record each service call request, as received. The record shall include the serial number identifying the component involved, its location, date and time the call was received, specific nature of trouble, names of service personnel assigned to the task, instructions describing the action taken, the amount and nature of the materials used, and the date and time of commencement and completion. Deliver a record of the work performed within five (5) working days after the work was completed.

F. System Modifications

1. Make any recommendations for system modification in writing to the COTR and the Owner Security Engineer. No system modifications, including operating parameters and control settings, shall be made without prior written approval from the COTR and the Owner Security Engineer.

1.12 Project Environmental Conditions

A. Control Station

1. Rated for continuous operation in ambient conditions of 60 to 85 deg F (16 to 30 deg C) and a relative humidity of 20 to 80 percent, non-condensing.

B. Interior, Controlled Environment

1. System components, except central-station control unit, installed in temperature-controlled interior environments shall be rated for continuous operation in ambient conditions of 36 to 122 deg F (2 to 50 deg C) dry bulb and 20 to 90 percent relative humidity, non-condensing. NEMA 250, Type 1 enclosure.

C. Interior, Uncontrolled Environment

1. System components installed in non-temperature-controlled interior environments shall be rated for continuous operation in ambient conditions of 0 to 122 deg F (-18 to 50 deg C) dry bulb and 20 to 90 percent relative humidity, non-condensing. NEMA 250, Type 4x enclosures.

D. Exterior Environment

1. System components installed in locations exposed to weather shall be rated for continuous operation in ambient conditions of -30 to 122 deg F (-34 to 50 deg C) dry bulb and 20 to 90 percent relative humidity, condensing. Rate for continuous operation where exposed to rain as specified in NEMA 250, winds up to 137 km/h (85 mph) and snow cover up to 24 in (610 mm) thick. NEMA 250, Type 4X enclosures.

E. Hazardous Environment

1. System components located in areas where fire or explosion hazards may exist because of flammable gases or vapors, flammable liquids, combustible dust, or ignitable fibers shall be rated, listed, and installed according to NFPA 70.

F. Corrosive Environment

1. For system components subjected to corrosive fumes, vapors, and wind-driven salt spray in coastal zones, provide NEMA 250, Type 4X enclosures.

G. Security Environment

1. Use vandal resistant enclosures in high-risk areas where equipment may be subject to damage.

1.13 Equipment and Materials

A. General Equipment Requirements

1. Equipment and materials shall be standard, current products of the manufacturer, and be suitable for the systems being installed and the intent of the design.
2. Plastic laminated nameplates shall be installed on all components accessed by - Smithsonian Institution Security Maintenance Personnel. Each nameplate shall identify the component and its location within the security system. The laminated plastic shall be 0.06 in (1.6 mm) thick, black with white lettering center core. Nameplates shall be a minimum of 0.75 in (19 mm) high, with a minimum of 0.13 in (3.3 mm) high-engraved block lettering. Nameplates are to be attached to the component with screws or located as required by security documentation plans and specifications. All console monitors shall be labeled with the monitor number and intended function. Submit planned naming conventions for approval.
3. Any material, device, or equipment damages including dents and marred finishes before or during installation and before acceptance of the completed system, shall be replaced unless repairs can be made that are acceptable to the COTR and the Owner Security Engineer. Any such replacement or repairs, including repairs to the finish, shall be made at no cost to the Owner.
4. Parts of the project site are finished spaces, including paint, trim, wall covering, floor treatments, lighting, and building mechanical systems. Therefore, perform the work specified herein, such that, at the completion of his work, all finished space is restored to the original condition existing prior to the commencement of work. During the course of performing the work specified herein, if the Contractor encounters any damaged finish in any area where the Contractor's work is to be performed, notify the COTR in writing prior to performing work in that area. Proceed with the work in these areas only after receiving written confirmation that the existing conditions have been documented and authorization has been given to proceed.

1.14 Component Enclosures

A. Tamper Provisions and Tamper Switches

1. Enclosures with terminal strips or circuit boards require tamper switches.
2. Arrange tamper switches to initiate an alarm signal that will report to the monitoring station when the door or cover is moved.
3. Tamper switches shall be inaccessible until the switch is activated. Be connected to circuits which are under electrical supervision at all times, irrespective of the protection mode in which the circuit is operating. Be spring-loaded and held in the closed position by the door or cover and be wired so they break the circuit when the door cover is disturbed. Tamper circuits shall be adjustable type screw sets and shall be adjusted by the contractor to eliminate nuisance alarms associated with incorrectly mounted tamper device shall annunciate prior to the enclosure door opening (within 1/4 " tolerance).
4. The single gang junction boxes for the portrait alarming and pull boxes with less than 102 square mm will not require tamper switches.
5. All enclosures over 12 sq in (305 sq mm) shall be hinged with an enclosure lock.
6. Control Enclosures: Maintenance/Safety switches on control enclosures, which must be opened to make routing maintenance adjustments to the system and to service the power supplies, shall be push/pull-set automatic reset type.
7. Provide one (1) enclosure tamper switch for each 24 in (609 mm) of enclosure lock side opening evenly spaced.
8. All security screws shall be Torx-Post Security Screws.

1.15 Warranty

A. The Contractor shall, as a condition precedent to the final payment, execute a written guarantee (warranty) to the COTR certifying all contract requirements have been completed according to the final specifications. Contract drawings and the warranty of all materials and equipment furnished under this contract are to remain in satisfactory operating condition (ordinary wear and tear, abuse and causes beyond his control for this work accepted) for one (1) year from the date the Contactor received written notification of final acceptance from the COTR and the Owner Security Engineer. Repair or replace all defects or damages due to faulty materials or workmanship without delay, to the COTR's satisfaction, and at the Contractor's expense.

B. When equipment and labor covered by the Contractor's warranty, or by a manufacturer's warranty, have been replaced or restored because of its failure during the warranty period, the warranty period for the replaced or repaired equipment or restored work shall be reinstated for a period equal to the original warranty period, and commencing with the date of completion of the replacement or restoration work. In the event any manufacturer customarily provides a warranty period greater than one (1) year, the Contractor's warranty shall be for the same duration for that component.

PART 2 - PRODUCTS

2.1 There are no products in this specification

PART 3 - EXECUTION

3.1 Common Requirements for Electronic Security Installation

A. Comply with NECA 1.

B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.

C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.

D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electronic safety and security equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.

E. Right of Way: Give to piping systems installed at a required slope.

3.2 General

A. The Contractor shall install all system components and appurtenances in accordance with the manufacturer’s instructions, ANSI C2, and furnish all necessary interconnections, services, and adjustments required for a complete and operable system as specified. Control signals, communications, and data transmission lines grounding shall be installed as necessary to preclude ground loops, noise, and surges from affecting system operation. Equipment, materials, installation, workmanship, inspection, and testing shall be in accordance with manufacturers’ recommendations and as modified herein.

B. Consult the manufacturer's installation manuals for all wiring diagrams, schematics, physical equipment sizes, etc., before beginning system installation. Refer to the Riser/Connection diagram for all schematic system installation/termination/wiring data.

C. All equipment shall be attached to walls and ceiling/floor assemblies and held firmly in place (e.g., sensors shall not be supported solely by suspended ceilings). Fasteners and supports shall be adequate to support the required load.

D. Current Site Conditions: The Contractor shall visit the site and verify site conditions are in agreement with the design package. The Contractor shall report all changes to the site or conditions that will affect performance of the system to the COTR a report as defined in paragraph Group II Technical Data Package. The Contractor shall take no corrective action without written permission from the COTR.

3.3 System Programming

A. General

1. The following Loading Sheet submittals are required:
   a. Shop Drawings – Technical Data Group I Submittal
   b. Final Construction Document Submittal – Technical Group VI Submittal
2. Loading Sheets
   a. See the attached loading sheets. Refer to Section 1 regarding loading sheet submissions.
   b. System Configuration and Data Entry:
      1) The contractor is responsible for providing all system configuration and data entry for the SMS and subsystems (e.g., intercom, Inovonics wireless, digital video recorders, network video recorders). All data entry shall be performed to Smithsonian Institution's standards & guidelines. The Contractor is responsible for participating in all meetings with the Owner Security Lead and the client to compile the information needed for data entry. These meetings shall be established at the beginning of the project and incorporated in to the project schedule as a milestone task. The contractor shall be responsible for all data collection, data entry, and system configuration. The contractor shall collect, enter, & program and/or configure the following components:
         a) Access control system components
         b) All intrusion detection system components
         c) Video surveillance, control and recording systems
         d) Intercom systems components
         e) All other security subsystems shown in the contract documents
3. Graphics
   a. Based on as-built drawings developed for the construction project, create all map sets and system icons showing locations of all alarms and field devices.
   b. Produce graphical maps of all alarm points installed under this contract including perimeter and exterior alarm points.
   c. Create and install all graphics needed to make the system operational.
   d. Utilize data from the contract documents, Contractor's field surveys, and all other pertinent information in the Contractor's possession to complete the graphics.
   e. Identify and request from the COTR and the Owner Security Engineer, any additional data needed to provide a complete graphics package.
   f. Graphics shall have sufficient level of detail for the system operator to assess the alarm.
   g. Supply hard copy, color examples at least 203.2 x 254 mm (8 x 10 in) of each type of graphic to be used for the completed Security system. Deliver the graphics examples to the COTR and the Owner Security Engineer for review and approval at least 90 calendar days prior to the scheduled date the Contractor requires them.

B. Alarm / Event Identification Format for Monitoring Station

1. Initial Descriptor
   a. The Initial Descriptor is a brief description of the event taking place and shall be no more than 50 characters in length. Contact Owner Security Lead for any Building ID, Area ID or Device / Condition Type not listed below.
   b. Building ID

1) This is a two (2) or four (4) character identification of the building where the event is taking place. This shall follow the standard format as shown in the listing below. Confirm buildings and identifications with the owner.

Building	ID	Building	ID
African Art	AA	Hirshhorn	HH
Air and Space	AS	Horticulture Greenhouse	HG
American History	AH	Library (STRI)	LB
American Indian (NY)	IN	Maintenance Shop (STRI)	TP
American Indian Mall	IM	MSC (Suitland)	MS
Anacostia	AN	NAOS (STRI)	NAOS
Ancon (STRI)	AC	National Zoological Park	NZ
Apollo Drive	AD	Natural History	NH
Arts and Industries	AB	NMAAHC	AAHC
Barro Colorado (STRI)	BC	Patent Office Building	PB
Bocas del Toro (STRI)	BT	Pennsy Drive	SISC
Capital Gallery	CG	Postal Museum	PM
Columbia Warehouse	CW	Quad	SQ
Conference Center (STRI)	CC	Renwick	RW
Cooper Hewitt (NY)	CH	Research Branch (NY)	RB
CRC (Suitland)	CR	Sackler	SK
Culebra (STRI)	CU	SAO Arizona	AZ
Dulles	DL	SAO Hilo HI	HI
Engineering Building (STRI)	EB	SAO Mauna Kea HI	MK
Folk Life Festival	FF	SCBI Front Royal VA	FZ
Freer	FR	SERC	SR
Galeta (STRI)	GA	SI Castle	SB
Gamboa (STRI)	GM	Tivoli Facility (STRI)	TV
Garber (Suitland)	GB	Tupper Facility (STRI)	TP
Herndon	HN	Victor Building	VB

c. Monitor Point Location
   1) This is the monitor point physical location. There is no separation between the Building ID and the Monitor Point Location.
   2) Description of iStar:
      a) The Monitoring Point Location includes a two (2) character descriptor for the iStar Cluster, followed by a colon and then a two (2) character descriptor for the iStar panel followed by a colon then a one (1) character space.
      b) Next is the one (1) character descriptor for ACM # (1 or 2) ‘ACM:#’ followed by a one (1) character space.
      c) Next is the device connection location for where the device terminates using ‘I8’ for an I-8 module, ‘R8’ for an R-8 module, ‘RDR’ for a reader module, followed by a colon. Then a one (1) character number representing which module it is (i.e. the fourth I-8 module),

followed by a colon. Last is a one (1) character number representing the input number on the module; the inputs on the ACM board require a two (2) character number.

3) Example of iStar
   a) xx01:01 ACM:1:i06 = iStar Cluster 01, iStar #01, ACM #1, main panel, sixth input
   b) xx01:02 ACM:2 I8:3:i6 = iStar Cluster 01, iStar #02, ACM#2, I-8 module #3, sixth input
   c) xx02:16 ACM:1 R8:2:o4 = iStar Cluster 02, iStar #16, ACM #1, R-8 module #2, fourth output
   d) xx01:15 ACM:1 RDR:4:i2 = iStar Cluster 01, iStar #15, ACM#1, reader module #4, second input

d. Area ID (Type)
   1) This is a brief description of the location of the alarm / event. There shall be a one (1) character space between the Monitor Point Location and the Area ID. At a minimum level of description, this shall follow the standard format as shown in the listing below. Confirm areas and identifications with the owner.

Description	Area ID
Vault	VAULT
Collection Storage	COLL STORAGE
Archive Areas	ARCHIVE
Collection Archive Areas	COLL ARCHIVE
Collection Processing / Preparation Areas	COLL PREP ROOM
Alcohol Storage Areas	ALCOHOL
Cold Collection Storage Areas	COLD STORAGE
Curatorial Areas	CURATORIAL
Exhibit Gallery (XX To be replaced with Gallery No.)	GALLERY XX
Exhibit Alarms Located in Lobbies or Reception Areas	LOBBY EXHIBIT
Exhibit or Artifact Alarms in “Other” Areas	MISC EXHIBIT
Registrar Areas	REGISTRAR
Perimeter Door, Glass Break, Motion	PERIMETER
Staff Cafeteria	STAFF CAFE
Public Access Cafeteria	PUBLIC CAFE
Public Staff Separation Door	STAFF DOOR
Museum Shop	MUSEUM SHOP
Museum Shop Storage Areas	MUSEUM SHOP ST
Cash Processing Areas	CASH ROOM
Automated Teller Machines	ATM
Executive Office Space	EXECUTIVE OFFICE
Support Staff Office Space	STAFF OFFICE
Loading Dock Areas	LOADING DOCK
Security Unit Control Room	UNIT CONTROL
Security Wire Closet	WIRE CLOSET OPS-

Description	Area ID
Computer Center Rooms	COMPUTER ROOM
Mechanical Room	MECHANICAL ROOM
Electrical Room	ELECTRICAL ROOM
Communication Closet	COMM CLOSET
Fabrication Shop	FABRICATION SHOP
Support Staff Storage Area	STAFF STORAGE
Warehouse Storage Area	WAREHOUSE
Shipping and Receiving Area	SHIPPING RECEIVING
Security Officer Kiosks / Posts	SECURITY POST
Information Booths	INFO BOOTH
Locker Rooms	LOCKER ROOM
Laboratories	LABORATORIES
Libraries	LIBRARY
Liquor Storage Areas	LIQUOR STORAGE
Child Care Centers	CHILD CARE
Photo Processing Laboratories	PHOTO LAB
Animal Area for Public Viewing	ANIMAL EXHIBIT
Animal Area not for Public Viewing	ANIMAL OFF-EXHIBIT
Outside Animal Area	ANIMAL YARD
Marine Animal Area	ANIMAL TANK
Animal/Keeper Area	KEEPER WORKROOM
Keeper (only) Area	KEEPER SPACE

e. Device / Condition Type

1) This is a two (2) digit descriptor for the type of device / condition that initiated the alarm / event. There is a one (1) character space between the Area ID and the Device / Condition Type. This follows the standard format as shown in the listing below. Confirm device / condition identifications with the owner.

Type of Device / Condition	ID
Door Contact	DC
Motion Detector	MD
Vibration Detector	VD
Glass Break Detector	GB
Hold Up / Duress Button	HU
Bill Trap (Last Bill Detector)	BT
Door Held Open	HO
Door Forced Open	FO
Power Failure	PF
Tamper Alarm	TP

Type of Device / Condition	ID
Window Contact	WC
Hazard Alarm	HZ
Case / Display Alarm	CA
Low / Missing Battery	LB
Communication Failure	CF
Security Fault	SF
UPS / Power Supply Trouble	PT
Restore / Reset	RS
Proximity Alarm	PA
Pressure Mat	PM

Type of Device / Condition	ID
Delayed Egress Pre Alarm	DE
Temperature Alarm	TA
Shock Sensor	SS
Photo Beam	PB
Request to Exit	REX
Seismic Alarm	SA
Video Loss	VL
Supervision Error	SE

Type of Device / Condition	ID
HVAC Duct Alarm	DA
Lock Secure	LS
Battery Fail	BF
Tamper Alarm	TP
Lock	LK
Door State Monitor	DSM
Sounder	SD

f. Examples for the Initial Descriptor:
   1) National Museum of Natural History monitor point location DGP chain 1 DGP number 2 first I-8 input 4, collection storage motion detector in alarm.
      a) NH01:02 I8:1:i4 COLL STORAGE MD
   2) Arts and Industries Building monitor point location DGP chain 3 DGP number 4 main panel input 6, public staff separation door contact.
      a) AB03:04 M:i6 STAFF DOOR DC

2. Secondary Descriptor
   a. The Secondary Descriptor is 128 characters
   b. This is an in-depth description for the location of the alarm / event taking place. If multiple devices are connected to the same monitor point the number of devices should be indicated.
   c. Examples for the secondary descriptor
      1) National Museum of Natural History monitor point location DGP chain 1, DGP number 6, I32 board input 31, collection storage motion detector in alarm.
         a) NH01:06 I32:i31 COLL STORAGE MD: NMNH 5th Fl East Wing Rm. 5210 Motion Detectors (3).
      2) Arts and Industries Building monitor point location DGP chain 1, DGP number 2 third I-8 board input 5, public staff separation door forced open.
         a) AB01:02 I8:3:i5 STAFF DOOR FO: AIB 1st Fl East Hall Card Access Door Forced Open.
   d. Linked Instruction Event
      1) This is a full instructional description for the processing of the alarm / event and follows the standard format of:
         a) Repeat 50 character descriptor
         b) In-depth description of location
         c) Response instructions
         d) Logging instructions
         e) Reset instructions
         f) Nearest camera location (If multiple views are available list all)
         g) DGP input is connected to
   e. Examples for the linked instructional event
      1) National Museum of Natural History monitor point location DGP chain 1 DGP number 3, I32 board input 31, collection storage motion detector in alarm.

Step	Display
1	NH01:03 I32:i31 COLL STORAGE MD

Step	Display
2	5th fl east wing Rm. 5210 motion detectors (3)
3	Dispatch officer to investigate and report findings
4	Log officer's name and actions into computer log
5	Device resets automatically when motion has stopped
6	Nearest camera is No. (camera Nos. provides other views)
7	Device connected to DGP

A. Alarm / Event Mapping Requirements

1. General

a. All maps associated with alarm / event call-ups shall be a black foreground on a white background.

2. Map Information Screen

a. The map information screen shall provide access to three different map levels for each event

b. Building Floor Map

1) This map has the quadrant where the event is taking place line colored blue or the colored event icon in place. Identify this map with the building name and floor at the bottom of the map.

c. Quadrant Map

1) This is the map called up by the system automatically upon event activation. Identify this map with the building name, floor number, and quadrant at the bottom of the map. This map has the icon representing the event shown upon call up. Clicking on the icon or a map "zoom in" icon at this map level calls up the Area map.

d. Area Map

1) This map represents the local area of the building where the event is taking place. This map contains all icons associated with this area. These icons are "living", changing colors as the associated devices change state. Identify this map with the building name, floor number, quadrant, and area name at the bottom of the map.

3. Mapping icons

a. Mapping icons are "living" changing color as the associated devices change state.

1) Red = alarm / activated state

2) Green = secure / normal state

3) Yellow = masked, shunted, accessed, etc. state

b. Group and position mapping icons represented on the Area map as follows:

1) Motion detectors providing back up to perimeter door(s) / window(s).

a) Place a single icon in a close geographical position to the protected door(s) or window(s), to represent all devices in the zone or group

2) Motion detectors providing back up to public staff separation doors and other internal doors.

a) Place a single icon in a close geographical position to the protected door.

3) Motion detectors providing volumetric protection of a room.

a) Place a single icon in the center of the room, to represent all devices in the zone or group

4) Glass break detectors protecting perimeter windows

a) Place a single icon in a close geographical position to the center of the window or group of windows, to represent all devices in the zone or group

5) Door contacts protecting individual perimeter doors or logical groups of perimeter doors.

a) Place a single icon in a close geographical position to the center of the door or group of doors, to represent all devices in the zone or group

6) Delayed egress pre alarm contacts protecting individual doors or logical groups of doors.

a) Place a single icon in a close geographical position to the center of the door or group of doors, to represent all devices in the zone or group.

7) Window contacts protecting individual perimeter windows or logical groups of perimeter windows.

a) Place a single icon in a close geographical position to the center of the window or group of windows, to represent all devices in the zone or group.

8) Card reader events to include door forced open and door held open alarms.

a) A single icon shall be the same as the door contact protecting the door.

b) Icon descriptor shall identify the appropriate event taking place.

9) Tamper alarms protecting panels in security closets.

a) Place a single icon in the center of the room, to represent all devices in the zone or group.

10) Tamper alarms protecting individual devices or logical groups of devices.

a) Place a single icon in close geographical position to the device or group of devices, to represent all devices in the zone or group.

11) Exhibit level case/display alarms.

a) A single icon shall represent all devices protecting the case/display.

b) Place icon directly over the case/display so the case outline is still visible below (around) the icon

c) Icon descriptor shall identify the appropriate device in alarm.

12) Vibration detectors protecting any physical barrier or point of entry.

a) Place a single icon in close geographical position to the physical barrier / point of entry or group of devices, to represent all devices in the zone or group.

B. System Programming

1. General Programming Requirements

a. Use the following section to identify the anticipated level of effort (LoE) required setup, program, and configuring the ESS.
b. Provide all setup, configuration, and programming to include data entry for the SMS and subsystems (e.g., video system, intercoms, digital video recorders, intrusion devices, maps and icons, time synchronization, including integration of subsystems to the SMS.

2. Configuration Management of Servers

a. Provide Owner the security system servers for baseline configuration 90 days before system programing begins.
b. Once the security system server is baselined according to OCIO requirements the server will be returned to the security contractor for system programing.
c. There are other programming requirements the contractor needs assistance on as follows:

1) Contractor has to enter the Levels and Permissions of programing.

2) Synchronize system with Genetec server

3) Employee card reader data will be automatically entered in the system server

4) Contractor will enter Card reader Clearances

3. Level of Effort for Programming

a. Perform and complete system programming (including all data entry) at an offsite location using the Contractor's own copy of the Genetec software which must be the same version Owner is using.
b. Deliver the completed forms (loading sheets) to the COTR and Owner Security Engineer for review and approval at least 90 calendar days prior to the scheduled date the Contractor requires it.
c. Once system programming has been completed, deliver the programming to the COTR and the PPSD Security engineer on data entry forms (loading sheets) and an approved electronic medium.
d. System programming may not be uploaded until the COTR and the Owner security Engineer provide written approval.
e. The Contractor is responsible for backing up the system prior to uploading new programming data.
f. Additional programming requirements are provided as follows.

1) Programming for New SMS Server

a) Provide all other system related programming.

b) Upload personnel information (e.g., ID Cards backgrounds, names, access privileges, personnel photos, access schedules, personnel groupings)

c) Coordinate with Owner Security Lead for device configurations, standards, and groupings. Owner shall provide database to support Contractor's data entry tasks.

d) Conduct a weekly coordination meeting and work alongside Owner Security Lead to ensure data uploading is performed without incident of loss of function or data loss.

2) Programming for Existing SMS Servers

a) Perform all related system programming except for personnel data as noted.

b) The contractor is not responsible for uploading personnel information (e.g., ID Cards backgrounds, names, access privileges, access schedules, personnel groupings).

c) Conduct a weekly coordination meeting and work alongside Owner Security Lead to ensure data uploading is performed without incident of loss of function or data loss.

d) Perform system programming for SMS servers using the Contractor's own server and software. These servers shall not be connected to existing devices or systems at any time.

g. Identify any additional data needed to provide a complete and operational system as described in the contract documents and request the information from the COTR and the Owner Security Engineer.

h. Programming effort requires a high level of coordination between Contractor and Owner Security Lead to ensure programming is performed in accordance with Owner requirements and programming uploads do not disrupt existing systems functionality.

1) Conduct a weekly coordination meeting and work alongside Owner Security Leadto ensure data uploading is performed without incident of loss of function or data loss.

i. Ensure data uploading is performed without incident or loss of function or data loss.

j. The following Level of Effort Chart is provided to communicate the expected level of effort required by contractors onOwner ESS projects. Determine actual levels of effort prior to bidding on the project.

SMS Setup & Configuration		
Description of Tasks	Develop System Loading Sheets	e.g., program monitoring stations, programming networks, interconnections between CCTV, intercoms, time synchronization
	Coordination	e.g., retrieve IP addresses, naming conventions, standard event descriptions, programming templates, coordinate special system needs
	Initial Set-up Configuration	e.g., Load system Operating System and Application software, general system configurations
	Graphic Maps	e.g., develop naming conventions, develop file folders, confirming accuracy of AutoCAD Floor Plans, convert file into jpeg file then to bitmap.bmp file
	System Programming	e.g., program monitoring stations, programming networks, interconnections between CCTV, intercoms, time synchronization
	Final Checks	e.g., check all system diagnostics (e.g., clients, panels)
	Level of Effort (Typical Tasks)	Load and set-up 4-6 CDs and configure servers (to configure Loading and Configuring software Administrative account, audit log Keystrokes, mouse clicks, multi-screen configuration
Electronic Entry Control Systems		
Description of Tasks	Develop System Loading Sheets	e.g., setup of device, door groups & schedules, REX, Locks, link graphics
	Coordination	e.g., confirming device configurations, naming conventions, event description and narratives
	Initial Set-up Configuration	e.g., enter data from loading sheets; configure components, link events, cameras, and graphics

	Graphic Maps	e.g., develop naming conventions, develop file folders, confirming accuracy of AutoCAD Floor Plans, convert file into jpeg file then to bitmap.bmp file
	System Programming	e.g., setup of device, door groups & schedules, REX, Locks, link graphics
	Final Checks	e.g., performing entry testing to confirm correct set-up and configuration
	Level of Effort (Typical Tasks)	e.g., creating a door, door configuration, adding request to exit, door monitors and relays, door timers, door related events (e.g., access, access denied, forced open, held open), linkages, controlled areas, advanced door monitoring, time zones, sequence of operations
Intrusion Detection Systems		
Description of Tasks	Develop System Loading Sheets	e.g., enter door groups & schedules, link devices - REX, lock, & graphics
	Coordination	e.g., confirming device configurations, naming conventions, event description and narratives
	Initial Set-up Configuration	e.g., enter data from loading sheets; configure components, link events, cameras, and graphics
	Graphic Maps	e.g., develop naming conventions, develop file folders, confirming accuracy of AutoCAD Floor Plans, convert file into jpeg file then to bitmap.bmp file
	System Programming	e.g., enter door groups & schedules, link devices - REX, lock, & graphics
	Final Checks	e.g., walk test, device position, and masking
	Level of Effort (Typical Tasks)	e.g., setting up monitoring and control points (e.g., motion sensors, glass breaks, vibration sensor, strobes, sounders) creating intrusion zones, creating arm/disarm panel, timed sequences, time zones, icon placements on graphic maps, clearance levels, events (e.g., armed, disarmed, zone violation, device alarm activations), LCD reader messages,
CCTV Systems		
Description of Tasks	Develop System Loading Sheets	e.g., programming call-ups recording
	Coordination	e.g., confirming device configurations, naming conventions
	Initial Set-up Configuration	e.g., enter data from loading sheets; camera naming convention, sequences, configure components)
	Graphic Maps	e.g., develop naming conventions, develop file folders, confirming accuracy of AutoCAD Floor Plans, convert file into jpeg file then to bitmap.bmp file
	System Programming	e.g., programming call-ups recording
	Final Checks	e.g., confirm area of coverage, call-up per event generated and recording rates
	Level of Effort (Typical Tasks)	e.g., setting up cameras points, recording ratios (e.g., normal, alarm event) timed recording, linkages, maps placements, call-ups
Intercoms Systems		
Description of Tasks	Develop System Loading Sheets	e.g., programming events & call-ups
	Coordination	e.g., confirming device configurations, naming conventions, event description and narratives

	Initial Set-up Configuration	e.g., enter data from loading sheets; configure components, link events, cameras, and graphics
	Graphic Maps	e.g., develop naming conventions, develop file folders, confirming accuracy of AutoCAD Floor Plans, convert file into jpeg file then to bitmap.bmp file
	System Programming	e.g., programming events & call-ups
	Final Checks	e.g., confirm operation, SMS event generation and camera call-up
	Level of Effort (Typical Tasks)	e.g., setup linkages, events for activations, device troubles, land devices on graphic maps
Console Monitoring Components		
Description of Tasks	Develop System Loading Sheets	N/A
	Coordination	per monitor
	Initial Set-up Configuration	per monitor
	Graphic Maps	e.g., develop naming conventions, develop file folders, confirming accuracy of AutoCAD Floor Plans, convert file into jpeg file then to bitmap.bmp file
	System Programming	N/A
	Final Checks	per monitor
	Level of Effort (Typical Tasks)	N/A

Note: Programming tasks are supported through the contractor's development of the Technical Data Package Submittals.

END OF SECTION

This page is intentionally left blank.

SECTION 28 05 09.10 - SURGE PROTECTION FOR ELECTRONIC SECURITY

PART 1 - GENERAL

1.1 SYSTEM DESCRIPTION

A. This specification is for surge protection for electronic security systems (ESS).

B. Transient Voltage Surge Suppression:

1. Protect cables and conductors extending beyond building façade, except fiber optic cables, which serve as communication, control, or signal lines against Transient Voltage surges and have Transient Voltage Surge Suppression (TVSS) protection.
2. The TVSS device shall be UL listed in accordance with Standard TIA 497B.
3. Lighting and surge suppression shall be a multi-strike variety and include a fault indicator.
4. Provide protection at the field device and on each wire line circuit at the first accessible location within the building but not more than 50 ft (15 m) of the building cable entrance.
5. Fuses shall not be used for surge protection.
6. Test the inputs and outputs in both normal mode and common mode to verify there is no interference.
7. General Performance Requirements

    a. A 10-microsecond rise time by 1000 microsecond pulse width waveform with a peak voltage of 1500 volts and a peak current of 60 amperes.
    b. An 8-microsecond rise time by 20-microsecond pulse width waveform with a peak voltage of 1000 volts and a peak current of 500 amperes.

1.2 SUMMARY

A. This Section includes the following:

1. TVSS

1.3 REFER TO 280500.10 FOR ALL OTHER PART I REQUIREMENTS

PART 2 - PRODUCTS

2.1 TVSS, POWER

A. Acceptable Manufacturers

1. Ditek
2. Approved Equivalent

B. Ditek DTK-4LVLPCR or approved equivalent

C. Minimum Features and Specifications

1. Suitable for surface mounting or DIN rail (DTK_DRK required) within the enclosure/rack.
2. Protects power (12V / 24V), data and LED circuits
3. Connection Method #22 - #16 AWG screw terminals
4. Single ground point for all protected circuits
5. Operating Temperature: -40 to 158 deg F (-40 to 70 deg C)

2.2 TVSS, ETHERNET POE

A. Ditek DTK-MRJPOE or approved equivalent

B. Minimum Features and Specifications

1. Suitable for surface mounting or DIN rail (DTK_DRK required) within the enclosure/rack.
2. Protects power, video and data PoE circuits
3. RJ45 connection with external grounding screw
4. Operating Temperature: -40 to 158 deg F (-40 to 70 deg C)

PART 3 - EXECUTION

3.1 GROUNDING

A. Comply with requirements in Section 270526.10 "Grounding and Bonding for Security Systems" for grounding conductors and connectors.

3.2 REFER TO 280500.10 FOR ALL OTHER PART III REQUIREMENTS

END OF SECTION

SECTION 28 05 11- CYBER SECURITY FOR ELECTRONIC SECURITY

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes criteria to enhance project cyber security.
B. Related Documents

1. 281300 - Access Control
2. 281523 - Intercom and Public Address
3. 281600 - Intrusion Detection
4. 282000 - Video Surveillance

1.2 REFERENCES

A. Abbreviations

1. AD – Active Directory
2. DMZ – Demilitarized Zone
3. FTP – File Transfer Protocol
4. ICMP – Internet Control Message Protocol
5. IT – Information Technology
6. NTP – Network Time Protocol
7. SNMP – Simple Network Management Protocol
8. SSL – Secure Sockets Layer
9. TLS – Transport Layer Security
10. VLAN – Virtual Local Area Network
11. VPN – Virtual Private Network

B. Reference Standards and Guidance

1. National Institute of Standards and Technology (NIST) CyberSecurity Framework
2. ISO/IEC 27000 Family of Standards
3. IEEE 802.1x – 2010 Standard for Local and Metropolitan Area Networks--Port-Based Network Access Control
4. ANSI/CAN/UL 2900-1:2017 - Standard for Software Cybersecurity for Network-Connectable Products, Part 1: General Requirements
5. Center for Internet Security – CIS Controls Version 7
6. Manufacturer Cybersecurity Hardening Guide

1.3 SUBMITTALS

A. Informational

1. Manufacturer cyber hardening manuals or guides.
2. Certification report by an acceptable independent testing organization of successful cyber vulnerability test of proposed product,
3. Certification testing shall have been completed no more than 12 months prior to submittal.
4. Contractor’s plan for secure assignment of unique strong passwords to all installed products requiring passwords.
5. Contractor’s plan for assignment of administrative and operator rights to installed products.
6. List of cloud services and providers to be provisioned.

B. Closeout

1. Asset Management

a. Secured spreadsheet or equivalent summary of all security devices and software installed to include:

1) Manufacturer, model, and firmware or software version
2) Serial number and MAC address, if applicable
3) Network settings, including IP address, VLAN or subnet mask, default gateway
4) Equipment location
5) Device user names and passwords

2. Licenses

a. License files and license key numbers
b. Additional codes required for operation

3. Services and ports

a. Summary of enabled and disabled product services
b. Summary of all open ports

4. Security recommendations

a. Summary of additional recommended physical, network, or program actions to enhance the cyber security of the installation.

5. Post-installation vulnerability test report

1.4 QUALIFICATIONS

A. Manufacturer shall have a documented process for secure development and testing of software code.
B. Manufacturer shall have a secure process for verifying and provisioning firmware and software updates.
C. Contractor personnel assigned to device programming and software installation shall have been certified in these tasks by the Manufacturer or possess industry certifications acceptable to the Manufacturer and the Owner attesting to the necessary competence.

1.5 SUPPORT

A. Manufacturer shall have a documented process for notifying and provisioning firmware or software updates to users of its products.

PART 2 - PRODUCTS

2.1 DEVICES

A. Security devices shall have the following properties:

1. Means to securely provision passwords
2. Controlled use of administrative privileges
3. Ability to synchronize with a common time base across all devices, such as an NTP server
4. Ability to disable all unneeded or unused services, including ICMP and discovery protocols
5. Option for encrypted communication and storage
6. Limitation on remote access
7. Support for secure versions of protocols to include HTTPS, Secure FTP, SNMP v3
8. Support for IEEE 802.1x, port-based network access control
9. Ability to prevent a valid digital certificate to third party and user processes

10. IP and MAC address filtering
11. Prompt for installer to change from default device password before security operation.

2.2 SERVERS

A. Servers shall be delivered with the server manufacturer, operating system(s) and provisioned applications full patched and testing to the latest supplier version.
B. Servers shall be provisioned with antivirus/anti-malware software acceptable to the Owner.
C. SQL (database) applications shall be provisioned on separate server(s).

2.3 CLIENTS

A. Client machines provided by the Contractor shall be delivered with the server manufacturer, operating system(s) and provisioned applications full patched and testing to the latest supplier version.
B. Supplied client machines shall be provisioned with antivirus/anti-malware software acceptable to the Owner.
C. Client shall be provisioned credentials in accordance with the principle of least privilege.
D. Client machines shall be provisioned with the minimum functionality required to perform their required tasks.

2.4 SOFTWARE

A. Application software shall have been developed in a secure coding environment, as certified by its manufacturer.
B. Software shall have been subjected to and successfully passed third party vulnerability testing within 12 months prior to Contractor proposal of the product.
C. Software shall have the ability to accept encrypted communication from remote client and field devices.
D. Required ports shall be clearly identified in the Manufacturer's documentation.
E. Software shall have configuration settings permitting back-up and failover in the event of the failure of its primary server.
F. Software shall have log capability to document user activity, performance, and usage patterns.
G. Review AI capable devices with Owner for use. Caution should be used when enabling any AI capable devices. Only enable AI capable devices with clear written direction from Owner.

2.5 NETWORK

A. The security system shall be isolated from other User systems via <firewall> <VLAN> <subnetting> in a manner acceptable to the User IT department.
B. Any network product deployed within this project shall be furnished with the latest manufacturer firmware.
C. Usernames and passwords, if applicable, shall be changed from their default value to be consistent with the strength of passwords provisioned in network connected devices.
D. Wireless Networks

1. Wireless transmission devices shall employ highest security suitable.
2. Wireless functionality shall be disabled on all devices not requiring it.

2.6 MOBILITY

A. Services for mobile services shall use only those ports recommended by the Manufacturer associated with the given service.
B. Mobile servers shall be placed in a DMZ with separate interfaces for internal and external access.
C. All non-essential protocols and services shall be disabled on the mobile services server.
D. Mobile services shall be provisioned with multi-factor authentication enabled.
E. Mobile communications shall be provisioned to operate only through HTTPS or secure VPN connections.

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 28 05 13 – CONDUCTORS AND CABLES FOR ELECTRONIC SECURITY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. UTP cabling.
2. RS-232 cabling.
3. RS-485 cabling.
4. Control-voltage cabling.
5. Control-circuit conductors.
6. Fire alarm wire and cable.
7. Identification products.

1.3 DEFINITIONS

A. EMI: Electromagnetic interference.
B. IDC: Insulation displacement connector.
C. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control and signaling power-limited circuits.
D. Open Cabling: Passing telecommunications cabling through open space (e.g., between the studs of a wall cavity).
E. RCDD: Registered Communications Distribution Designer.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordinate layout and installation of electronic safety and security cabling with Owner's telecommunications and LAN equipment and service suppliers.
B. Coordinate telecommunications outlet/connector locations with location of power receptacles at each work area.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Installation data for UTP and optical-fiber cables as specified in TIA 569-C-1.

2. For coaxial cable, include the following installation data for each type used:

a. Nominal OD.
b. Minimum bending radius.
c. Maximum pulling tension.

B. Shop Drawings:

1. System Labeling Schedules: Electronic copy of labeling schedules, in software and format selected by Owner.
2. System Labeling Schedules: Electronic copy of labeling schedules that are part of the cabling and asset identification system of the software.

3. Cabling administration drawings and printouts.
4. Wiring diagrams to show typical wiring schematics, including the following:

    a. Cross-connects.
    b. Patch panels.
    c. Patch cords.

5. Cross-connects and patch panels. Detail mounting assemblies, and show elevations and physical relationship between the installed components.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified layout technician, installation supervisor, and field inspector.
B. Source quality-control reports.

C. Field quality-control reports.

1.7 QUALITY ASSURANCE

A. Testing Agency Qualifications: An NRTL.

1. Testing Agency's Field Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: **25** or less.
2. Smoke-Developed Index: **50** or less.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.2 BACKBOARDS

A. Backboards: Plywood, fire-retardant treated, 3/4 by 48 by 96 inches .Comply with requirements for plywood backing panels in Section 061000 "Rough Carpentry."

2.3 UTP CABLE

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Belden Inc.
2. Berk-Tek Leviton; a Nexans/Leviton alliance.
3. CommScope, Inc.
4. Hubbell Electrical Solutions; Hubbell Incorporated.
5. Mohawk Cable; brand of Belden, Inc.
6. West Penn Wire; brand of Belden, Inc.

B. Description: 100-ohm, four-pair UTP, covered with a **purple** thermoplastic jacket.

1. Comply with ICEA S-90-661 for mechanical properties.
2. Comply with TIA-568-C.1 for performance specifications.
3. Comply with TIA-568-C.2, Category 6A.
4. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444 and NFPA 70 for the following types:

    a. Communications, Plenum Rated: Type CMP or Type MPP, complying with NFPA 262.

2.4 UTP CABLE HARDWARE

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. American Technology Systems Industries, Inc.
2. Belden Inc.
3. Hubbell Electrical Solutions; Hubbell Incorporated.
4. Leviton Manufacturing Co., Inc.
5. Panduit Corp.
6. West Penn Wire; brand of Belden, Inc.

B. UTP Cable Connecting Hardware: IDC type, using modules designed for punch-down caps or tools. Cables shall be terminated with connecting hardware of the same category or higher.

C. Connecting Blocks: 110-style for Category 6A Provide blocks for the number of cables terminated on the block, plus 25 percent spare. Integral with connector bodies, including plugs and jacks where indicated.

2.5 RS-232 CABLE

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Allied Wire & Cable Inc.
2. Belden Inc.
3. Southwire Company, LLC.

B. Standard Cable: NFPA 70, Type CM.

1. Three, No. 22 AWG, stranded (7x30) tinned copper conductors.
2. Polypropylene insulation.
3. Aluminum foil-polyester tape shield with 100 percent shield coverage.
4. PVC jacket.
5. Conductors are cabled on common axis with No. 24 AWG, stranded (7x32) tinned copper drain wire.
6. Flame Resistance: Comply with UL 1581.

C. Plenum-Rated Cable: NFPA 70, Type CMP.

1. Three, No. 22 AWG, stranded (7x30) tinned copper conductors.
2. PE insulation.
3. Aluminum foil-polyester tape shield with 100 percent shield coverage.
4. Fluorinated ethylene propylene jacket.
5. Conductors are cabled on common axis with No. 24 AWG, stranded (7x32) tinned copper drain wire.
6. Flame Resistance: Comply with NFPA 262.

2.6 RS-485 CABLE

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Allied Wire & Cable Inc.
2. Belden Inc.
3. Southwire Company, LLC.

B. Standard Cable: NFPA 70, Type CM or Type CMG.

1. Paired, two pairs, twisted, No. 22 AWG, stranded (7x30) tinned copper conductors.
2. PVC insulation.
3. Unshielded.
4. PVC jacket.
5. Flame Resistance: Comply with UL 1581.

C. Plenum-Rated Cable: NFPA 70, Type CMP.

1. Paired, two pairs, No. 22 AWG, stranded (7x30) tinned copper conductors.
2. Fluorinated ethylene propylene insulation.
3. Unshielded.
4. Fluorinated ethylene propylene jacket.
5. Flame Resistance: NFPA 262, Flame Test.

2.7 CONTROL-VOLTAGE CABLE

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Allied Wire & Cable Inc.
2. Belden Inc.
3. Southwire Company, LLC.

B. Paired Cable: NFPA 70, Type CMG.

1. One pair, twisted, No. 16 AWG, stranded (19x29)] and No. 18 AWG, stranded (19x30)] tinned copper conductors.
2. PVC insulation.
3. Unshielded.
4. PVC jacket.
5. Flame Resistance: Comply with UL 1581.

C. Plenum-Rated, Paired Cable: NFPA 70, Type CMP.

1. One pair, twisted, No. 16 AWG, stranded (19x29) and No. 18 AWG, stranded (19x30)] tinned copper conductors.
2. PVC insulation.
3. Unshielded.
4. PVC jacket.
5. Flame Resistance: Comply with NFPA 262.

2.8 CONTROL-CIRCUIT CONDUCTORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Allied Wire & Cable Inc.
2. Belden Inc.
3. Southwire Company, LLC.

B. Class 1 Control Circuits: Stranded copper, Type THHN-THWN, complying with UL 83, in pathway XLP/PVC tray cable, complying with UL 83, in cable tray].
C. Class 2 Control Circuits: Stranded copper, Type THHN-THWN, complying with UL 83, in pathway, concealed in building finishes.
D. Class 3 Remote-Control and Signal Circuits: Stranded copper, Type TW or TF in pathway, complying with UL 83.

2.9 CONSOLIDATION POINTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. American Technology Systems Industries, Inc.
2. Belden Inc.
3. Chatsworth Products, Inc.
4. Dynacom Corporation.
5. Hubbell Premise Wiring; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
6. Molex Connected Enterprise Solutions; business of Molex, LLC; Koch Industries.
7. Ortronics, Inc.
8. Panduit Corp.
9. Siemon Co. (The).

B. Description: Consolidation points shall comply with requirements for cable connecting hardware.

1. Number of Terminals per Field: One for each conductor in assigned cables.

2. Number of Connectors per Field:

a. One for each four-pair UTP cable indicated.
b. One for each four-pair conductor group of indicated cables, plus 25 percent spare positions.

3. Mounting: Recessed in ceiling.
4. NRTL listed as complying with UL 50 and UL 1863.
5. When installed in plenums used for environmental air, NRTL listed as complying with UL 2043.

2.10 IDENTIFICATION PRODUCTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Brady Corporation.
2. HellermannTyton.
3. Kroy LLC.
4. Panduit Corp.

B. Comply with TIA-606-B and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.
C. Comply with requirements in Section 260553 "Identification for Electrical Systems."

2.11 SOURCE QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to evaluate cables.
B. Factory test UTP and optical-fiber cables on reels according to TIA-568-C.1.
C. Factory test UTP cables according to TIA-568-C.2.
D. Factory test multimode optical fiber cables according to TIA-526.14-B and TIA-568-C.3.

E. Factory sweep test coaxial cables at frequencies from 5 MHz to 1 GHz. Sweep test shall test the frequency response, or attenuation over frequency, of a cable by generating a voltage whose frequency is varied through the specified frequency range and graphing the results. Structural Return Loss shall be less than 20 db.
F. Cable will be considered defective if it does not pass tests and inspections.
G. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 INSTALLATION OF HANGERS AND SUPPORTS

A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for installation of supports for cables.

3.2 WIRING METHOD

A. Install wiring in metal pathways and wireways.

1. Minimum conduit size shall be **3/4 inch**. Control and data-transmission wiring shall not share conduits with other building wiring systems.
2. Comply with requirements in Section 280528 "Pathways for Electronic Safety and Security."
3. Comply with requirements in Section 260536 "Cable Trays for Electrical Systems."
4. Comply with requirements in Section 270536 "Cable Trays for Communications Systems."

B. Install cable, concealed in accessible ceilings, walls, and floors when possible.
C. Wiring on Racks and within Enclosures:

1. Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIM's "Cabling Termination Practices" chapter. Cable ties shall not be excessively tightened such that the transmission characteristics of the cable are altered.
2. Install lacing bars and distribution spools.
3. Separate power-limited and non-power-limited conductors as recommended in writing by manufacturer.
4. Install conductors parallel with or at right angles to sides and back of enclosure.
5. Connect conductors associated with intrusion system that are terminated, spliced, or interrupted in any enclosure onto terminal blocks.
6. Mark each terminal according to system's wiring diagrams.
7. Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

A. Comply with NECA 1 and NFPA 70.
B. Conductors: Size according to system manufacturer's written instructions unless otherwise indicated.
C. Do not install conductors and cables that are wet, moisture damaged, or mold damaged.

D. Install UTP, optical-fiber, and coaxial cables and connecting materials after spaces are complete and dry, and HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

E. General Requirements for Cabling:

1. Comply with TIA-568-C.1.
2. Comply with BICSI ITSIM, Ch. 6, "Cable Termination Practices."
3. Terminate all conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, and cross-connect and patch panels. Leave a minimum of 6 inches (150 mm) of slack at outlet terminations and coil loosely into box after termination on outlet fitting.
4. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches (760 mm) and not more than 6 inches (150 mm) from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
5. Maintain minimum cable bending radius during installation and termination of cables.
6. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
7. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
8. Pulling Cable: Comply with BICSI ITSIM, Ch. 4, "Pulling Cable." Monitor cable pull tensions. Do not exceed manufacturer's rated cable-pulling tension.
9. Riser Cable: Riser cable support intervals shall be in accordance with manufacturer's recommendations.
10. Comply with Section 280544 "Sleeves and Sleeve Seals for Electronic Safety and Security Pathways and Cabling."

F. UTP Cable Installation: Install using techniques, practices, and methods that are consistent with Category 6A rating of components and that ensure Category 6A performance of completed and linked signal paths, end to end.

1. Comply with TIA-568-C.2.
2. Install 110-style IDC termination hardware unless otherwise indicated.
3. Do not untwist UTP cables more than 1/2 inch (12 mm) from point of termination to maintain cable geometry.

G. Optical-Fiber Cable Installation:

1. Comply with TIA-568-C.3.
2. Cable shall be terminated on connecting hardware that is rack or cabinet mounted.

H. Coaxial-Cable Installation:

1. Install outdoor connections in enclosures complying with NEMA 250, Type 4X. Install corrosion-resistant connectors with properly designed O-rings to keep out moisture.
2. Attach antenna lead-in cable to support structure at intervals not exceeding 36 inches (915 mm).
3. Install indoor cables in pathway.

I. Open-Cable Installation:

1. Install cabling with horizontal and vertical cable guides in telecommunication spaces with terminating hardware and interconnection equipment.
2. Suspend copper cable not in a wireway or pathway a minimum of 8 inches above ceilings by cable supports not more than 48 inches apart. Cable supports shall be fastened to structural members or floor slabs in accordance with Section 260529 "Hangers and Supports for Electrical Systems."

3. Cable shall not be run in contact with pipes, ducts, or other potentially damaging items. Cables shall not be run through structural members or use structural members, pipes, ducts, or equipment as a support.

J. Installation of Cable Routed Exposed under Raised Floors:

1. Install plenum-rated cable only.
2. Install cabling after the flooring system has been installed in raised floor areas.
3. Cable 72 inches long shall be neatly coiled not less than 12 inches in diameter below each feed point.

K. Separation from EMI Sources:

1. Comply with BICSI TDMM and TIA-569-C recommendations for separating unshielded copper voice and data communication cable from potential EMI sources, including electrical power lines and equipment.
2. Separation between open communication cables or cables in nonmetallic pathways and unshielded power conductors and electrical equipment shall be as follows:

   a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches (127 mm).
   b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches (300 mm).
   c. Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches (600 mm).

3. Separation between communication cables in grounded metallic pathways and unshielded power lines or electrical equipment shall be as follows:

   a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches (64 mm).
   b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches (150 mm).
   c. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches (300 mm).

4. Separation between cables in grounded metallic pathways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:

   a. Electrical Equipment Rating Less Than 2 kVA: No requirement.
   b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches (75 mm).
   c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches (150 mm).

5. Separation between Cables and Electrical Motors and Transformers, 5 kVA or hp and Larger: A minimum of 48 inches (1200 mm).
6. Separation between Cables and Fluorescent Fixtures: A minimum of 5 inches (127 mm).

3.4 POWER AND CONTROL-CIRCUIT CONDUCTORS

A. 120-V Power Wiring: Install according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables" unless otherwise indicated.
B. Minimum Conductor Sizes:

1. Class 1 remote-control and signal circuits, No. 14 AWG.
2. Class 2 low-energy, remote-control and signal circuits, No. 16 AWG.
3. Class 3 low-energy, remote-control, alarm and signal circuits, No. 12 AWG.

3.5 CONNECTIONS

A. Comply with requirements in Section 281600 "Intrusion Detection" for connecting, terminating, and identifying wires and cables.
B. Comply with requirements in Section 281300 "Access Control" for connecting, terminating, and identifying wires and cables.
C. Comply with requirements in Section 282300 "Video Surveillance" for connecting, terminating, and identifying wires and cables.

3.6 FIRESTOPPING

A. Comply with requirements in Section 078413 "Penetration Firestopping."
B. Comply with TIA-569-C, "Firestopping" Annex A.
C. Comply with BICSI TDMM, "Firestopping Systems" Article.

3.7 GROUNDING

A. For communication wiring, comply with J-STD-607-A and with BICSI TDMM's "Grounding, Bonding, and Electrical Protection" chapter.
B. For low-voltage wiring and cabling, comply with requirements in Section 280526 "Grounding and Bonding for Electronic Safety and Security."

3.8 IDENTIFICATION

A. Identify system components, wiring, and cabling complying with TIA-606-B. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.9 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

C. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. Visually inspect UTP and optical-fiber cable jacket materials for NRTL certification markings. Inspect cabling terminations to confirm color coding for pin assignments, and inspect cabling connections to confirm compliance with TIA-568-C.1.
2. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.

3. Test UTP cabling for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination but not cross connection.

    a. Test instruments shall comply with or exceed applicable requirements in TIA-568-C.2. Perform tests with a tester that complies with performance requirements in "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.

4. Optical-Fiber Cable Tests:

a. Test instruments shall comply with or exceed applicable requirements in TIA-568-C.1. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
b. Link End-to-End Attenuation Tests:

1) Multimode Link Measurements: Test at 850 or 1300 nm in one direction according to TIA-526-14-B, Method B, One Reference Jumper.
2) Attenuation test results for links shall be less than 2.0 db. Attenuation test results shall be less than that calculated according to equation in TIA-568-C.1.

5. Coaxial-Cable Tests:

a. Align and adjust system and pretest components, wiring, and functions to verify that they comply with specified requirements.
b. Replace malfunctioning or damaged items.
c. Retest until satisfactory performance and conditions are achieved.
d. Use an agile receiver and signal strength meter or spectrum analyzer for testing.
e. CCTV Sources: Connect receiver to the output of each CCTV signal source or the distribution amplifier associated with it.
f. Test Schedule: Schedule tests after pretesting has successfully been completed and system has been in normal functional operation for at least 14 days. Provide a minimum of 10 days' notice of test schedule.
g. Operational Tests: Perform tests of operational system to verify that system complies with Specifications. Include all modes of system operation. Test equipment for proper operation in all functional modes.
h. Distribution System Acceptance Tests:

1) Field-Strength Instrument: Rated for minus 40-db mV measuring sensitivity and a frequency range of 54 to 812 MHz, minimum. Provide documentation of recent calibration against recognized standards.
2) Signal Level and Picture Quality: Use a field-strength meter or spectrum analyzer, as well as a standard television receiver, to measure signal levels and check picture quality at all user-interface outlets.

a) Test the signal strength in db mV at 55, 151, 547, and 750 MHz.
b) Minimum acceptable signal level is zero db mV (1000 mV).
c) Maximum acceptable signal level over the entire bandwidth is 15 db mV.
d) Television receiver shall show no evidence of cross-channel intermodulation, ghost images, or beat interference.

i. Signal-to-Noise-Ratio Test: Use a field-strength meter to make a sequence of measurements at the output of the last distribution amplifier or of another agreed-on location in system. With system operating at normal levels, tune meter to the picture carrier frequency of each of the designated channels in turn, and record the level. With signal removed and input to corresponding headend amplifier terminated at 75 ohms, measure the level of noise at same tuning settings. With meter correction factor added to last readings, differences from first set shall not be less than 45 db.
j. Qualitative and Quantitative Performance Tests: Demonstrate reception quality of color-television program transmissions at each user interface from each designated channel and source. Quality shall be equal or superior to that obtained with performance checks specified below, using a standard, commercial, cable-ready, color-television receiver. Level and quality of signal at each outlet and from each service and source shall comply with the following Specifications when tested according to 47 604-12 76:

1) RF video-carrier level.
2) Relative video-carrier level.
3) Carrier-level stability, during 60-minute and 24-hour periods.
4) Broadband frequency response.
5) Channel frequency response.
6) Carrier-to-noise ratio.
7) RF visual signal-to-noise ratio.
8) Antenna combiner insertion loss.
9) Signal power splitter loss.
10) Cable connector attenuation.

11) Cross modulation.
12) Carrier-to-echo ratio.
13) Composite triple beat.
14) Second order beat.
15) Terminal isolation.
16) Terminal isolation between television and FM.
17) Hum modulation.

18) RF FM carrier level.
19) FM frequency response.
20) FM carrier-to-noise ratio.

D. Document data for each measurement. Print data for submittals in a summary report that is formatted using Table 10.1 in BICSI TDMM as a guide, or transfer the data from the instrument to the computer, save as text files, print, and submit.

E. End-to-end cabling will be considered defective if it does not pass tests and inspections.
F. Prepare test and inspection reports.

END OF SECTION

This page is intentionally left blank.

SECTION 280513.10 – SERVERS, WORKSTATIONS, AND STORAGE FOR ELECTRONIC SECURITY

1.1 SYSTEM DESCRIPTION

A. This specification is for the servers, workstations, and storage directly supporting the electronic security systems (ESS) including all software licenses.

1.2 SUMMARY

A. This Section includes the following:

1. Operator Workstations
2. Video Walls
3. Access Control Servers
4. NVR's
5. Intercom Server

1.3 REFER TO 280500.10 FOR ALL OTHER PART I REQUIREMENTS

PART 2 - PRODUCTS

2.1 OPERATOR WORKSTATION

A. Acceptable Manufacturers

1. Dell

B. Dell or approved equivalent

C. Minimum Features and specifications

1. OptiPlex 7000 Small Form Factor
2. 12th Gen Intel® Core™ i7-12700
3. Windows 10 Pro (Dell Technologies recommends Windows 11 Pro for business)
4. Intel® Integrated Graphics
5. 32 GB, DDR4
6. 512 GB Solid State Drive for OS and Security Center applications, with a minimum of 6 GB of free disk space to install the Security Center client application.
7. GbE network interface card
8. Dual NVIDIA® GeForce® RTX 2080 video card
9. Dell Pro Wireless Keyboard and Mouse (Black) KM5221W
10. Provide Dell Secured Wall Mount Kit (Below Counter)
11. Dell 27" Flat Screen Monitor
12. When discontinued, Provide Manufacturer Recommended Replacement

2.2 VIDEO WALL

A. 43" Flatscreen Monitor, quantity per plan

1. 43" Us 4K USB C Monitor U4320Q
2. Provide Compatible Z Bracket for Wall Mount

B. Dell Small Form Factor PC

1. OptiPlex 7000 Micro
2. 12th Gen Intel® Core™ i7-12700T
3. Windows 10 Pro (Dell Technologies recommends Windows 11 Pro for business)
4. 16 GB, DDR4
5. 512 GB, M.22230, PCIe NVe, SSD, Class 35
6. Dell Pro Wireless Keyboard and Mouse (Black) KM5221W
7. Provide Dell Wall Mount Kit (behind Monitor)
8. When discontinued, Provide Manufacturer Recommended Replacement

2.3 ACCESS CONTROL SERVER

A. Acceptable Manufacturers

1. Dell

B. Dell or approved equivalent

C. Minimum Features and specifications

1. Rack Mounted Chassis

2.4 NETWORK VIDEO RECORDER

A. Acceptable Manufacturers

1. Genetec

B. Genetec or approved equivalent

C. Minimum Features and Specifications

2.5 INTERCOM & PUBLIC ADDRESS SERVER

A. Acceptable Manufacturers

1. 2N

B. Genetec or approved equivalent

C. Minimum Features and Specifications

PART 3 - EXECUTION

3.1 GROUNDING

A. Comply with requirements in Section 270526.10 "Grounding and Bonding for Security Systems" for grounding conductors and connectors.

3.2 OPERATOR WORKSTATION

A. Provide the workstation hardware to Owner for image with operating system and baseline configuration and scan for vulnerabilities.

B. Owner will provide the workstation back to the Contractor for installation and configuration of project specific software and licenses.

3.3 ACCESS CONTROL SERVER

A. Provide the Access Control Server hardware to Owner to image with operating system and baseline configuration and scan for vulnerabilities.

B. Owner will provide the server back to the Contractor for installation and configuration of project specific software and licenses.

3.4 REFER TO 280500.10 FOR ALL OTHER PART III REQUIREMENTS

END OF SECTION

This page is intentionally left blank.

SECTION 28 05 26.10 - GROUNDING AND BONDING FOR ELECTRONIC SECURITY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Grounding conductors.
2. Grounding connectors.
3. Grounding busbars.

1.3 DEFINITIONS

A. Signal Ground: The ground reference point designated by manufacturer of the system that is considered to have zero voltage.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 CONDUCTORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Allied Tube & Conduit; Atkore International.
2. Harger Lightning & Grounding; business of Harger, Inc.
3. Panduit Corp.
4. TE Connectivity Ltd.

B. Comply with UL 486A-486B.

C. Insulated Conductors: Stranded copper wire, green or green with yellow stripe insulation, insulated for 600 V, and complying with UL 83.

1. Ground wire for custom-length equipment ground jumpers shall be No. 6 AWG, 19-strand, UL-listed, Type THHN wire.

D. Bare Copper Conductors:

1. Solid Conductors: ASTM B 3.
2. Stranded Conductors: ASTM B 8.
3. Tinned Conductors: ASTM B 33.

4. Bonding Cable: 28 kcmils (14.2 sq. mm), 14 strands of No. 17 AWG conductor, and 1/4 inch (6.3 mm) in diameter.
5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.

6. Bonding Jumper: Tinned-copper tape, braided conductors terminated with two-hole copper ferrules; 1-5/8 inches (41 mm) wide and 1/16 inch (1.6 mm) thick.

2.2 CONNECTORS

A. Irreversible connectors listed for the purpose. Listed by an NRTL as complying with NFPA 70 for specific types, sizes, and combinations of conductors and other items connected. Comply with UL 486A-486B.
B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Burndy; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
2. Chatsworth Products, Inc.
3. Harger Lightning & Grounding; business of Harger, Inc.
4. Panduit Corp.
5. TE Connectivity Ltd.

C. Compression Wire Connectors: Crimp-and-compress connectors that bond to the conductor when the connector is compressed around the conductor. Comply with UL 467.

1. Electroplated tinned copper, C and H shaped.

D. Busbar Connectors: Cast silicon bronze, solderless **compression** type mechanical connector; with a long barrel and two holes spaced on 5/8- or 1-inch (15.8- or 25.4-mm) centers for a two-bolt connection to the busbar.
E. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

2.3 GROUNDING BUSBARS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Chatsworth Products, Inc.
2. Harger Lightning & Grounding; business of Harger, Inc.
3. Panduit Corp.

B. Grounding Busbars: Predrilled rectangular bars of hard-drawn solid copper, **1/4 by 2 inches** in cross section, length as indicated on Drawings. The busbar shall be for wall mounting, shall be NRTL listed as complying with UL 467, and shall comply with J-STD-607-A.

1. Predrilling shall be with holes for use with lugs specified in this Section.
2. Mounting Hardware: Stand-off brackets that provide at least a 2-inch (50-mm clearance to access the rear of the busbar. Brackets and bolts shall be stainless steel.)
3. Stand-off insulators for mounting shall be Lexan or PVC. Comply with UL 891 for use in 600 V switchboards, impulse tested at 5000 V.

C. Rack and Cabinet Grounding Busbars: Rectangular bars of hard-drawn solid copper, accepting conductors ranging from No. 14 to No. 2/0 AWG, NRTL listed as complying with UL 467, and complying with J-STD-607-A. Predrilling shall be with holes for use with lugs specified in this Section.

1. Cabinet-Mounted Busbar: Terminal block, with stainless-steel or copper-plated hardware for attachment to the cabinet.
2. Rack-Mounted Horizontal Busbar: Designed for mounting in 19- or 23-inch (483- or 584-mm) equipment racks. Include a copper splice bar for transitioning to an adjoining rack, and stainless-steel or copper-plated hardware for attachment to the rack.

3. Rack-Mounted Vertical Busbar: 72 or 36 inches (1827 or 914 mm long, with)stainless-steel or copper-plated hardware for attachment to the rack.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with IEEE 1100, "Recommended Practice for Power and Grounding Electronic Equipment."

1. Ground cable shields, drain conductors, and equipment to eliminate shock hazard and to minimize ground loops, common-mode returns, noise pickup, cross talk, and other impairments.
2. Bond shields and drain conductors to ground at only one point in each circuit.

B. Signal Ground:

1. For each system, establish the signal ground and label that location as such.

2. Bond the signal ground to the alternating-current (ac) power system service by connecting to one of the following listed locations, using insulated **No. 6 AWG,** stranded, Type THHN wire:

a. Grounding bar in an electrical power panelboard if located in the same room or space as the signal ground.
b. Telecommunications grounding busbar.

C. Comply with NECA 1.

3.2 APPLICATION

A. Conductors: Install solid conductor for **No. 8** AWG and smaller and stranded conductors for **No. 6** AWG and larger unless otherwise indicated.
B. Grounding and Bonding Conductors:

1. Install in the straightest and shortest route between the origination and termination point, and no longer than required. The bend radius shall not be smaller than eight times the diameter of the conductor. No one bend may exceed 90 degrees.
2. Install without splices.
3. Support at not more than 36-inch (900-mm) intervals.

3.3 CONNECTIONS

A. Stacking of conductors under a single bolt is not permitted when connecting to busbars.
B. Assemble the wire connector to the conductor, complying with manufacturer's written instructions and as follows:

1. Use crimping tool and the die specific to the connector.
2. Pretwist the conductor.
3. Apply an antioxidant compound to all bolted and compression connections.

C. Shielded Cable: Bond the shield of shielded cable to the signal ground. Comply with TIA/EIA-568-B.1 and TIA/EIA-568-B.2 when grounding screened, balanced, twisted-pair cables.
D. Rack- and Cabinet-Mounted Equipment: Bond powered equipment chassis to the cabinet or rack grounding bar. Power connection shall comply with NFPA 70; the equipment grounding conductor in the power cord of cord- and plug-connected equipment shall be considered as a supplement to bonding requirements in this Section.

3.4 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

1. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.

C. Grounding system will be considered defective if it does not pass tests and inspections.
D. Prepare test and inspection reports.

END OF SECTION

SECTION 28 05 28.10 – PATHWAYS FOR ELECTRONIC SECURITY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Metal conduits, tubing, and fittings.
2. Nonmetallic conduits, tubing, and fittings.
3. Optical-fiber-cable pathways and fittings.
4. Metal wireways and auxiliary gutters.
5. Nonmetallic wireways and auxiliary gutters.
6. Surface pathways.
7. Boxes, enclosures, and cabinets.
8. Handholes and boxes for exterior underground cabling.

B. Related Requirements:

1. Section 260543 "Underground Ducts and Raceways for Electrical Systems" for exterior ductbanks, manholes, and underground utility construction.
2. Section 260533 "Raceways and Boxes for Electrical Systems" for conduits, wireways, surface raceways, boxes, enclosures, cabinets, handholes, and faceplate adapters serving electrical systems.
3. Section 270528 "Pathways for Communications Systems" for conduits, surface pathways, innerduct, boxes, and faceplate adapters serving communications systems.

1.3 DEFINITIONS

A. ARC: Aluminum rigid conduit.
B. GRC: Galvanized rigid steel conduit.
C. IMC: Intermediate metal conduit.

1.4 ACTION SUBMITTALS

A. Product Data: For surface pathways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.
B. Shop Drawings: For custom enclosures and cabinets. Include plans, elevations, sections, and attachment details.
C. Samples: For wireways and for each color and texture specified, 12 inches long.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Pathway routing plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of items involved:

1. Structural members in paths of pathway groups with common supports.
2. HVAC and plumbing items and architectural features in paths of conduit groups with common supports.

B. Qualification Data: For professional engineer.

C. Seismic Qualification Certificates: For pathway racks, enclosures, cabinets, and equipment racks and their mounting provisions, including those for internal components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which certification is based and their installation requirements.
4. Detailed description of conduit support devices and interconnections on which certification is based and their installation requirements.

D. Source quality-control reports.

PART 2 - PRODUCTS

2.1 METAL CONDUITS, TUBING, AND FITTINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. ABB, Electrification Business.
2. AFC Cable Systems; Atkore International.
3. Allied Tube & Conduit; Atkore International.
4. Alpha Wire; brand of Belden, Inc.
5. Anaconda Sealtite; Anamet Electrical, Inc.
6. Electri-Flex Company.
7. O-Z/Gedney; brand of Emerson Electric Co., Automation Solutions, Appleton Group.
8. Picoma; Zekelman Industries.
9. Plasti-Bond; Robroy Industries.
10. Republic Conduit; Nucor Corporation, Nucor Tubular Products.
11. Southwire Company, LLC.
12. Western Tube; Zekelman Industries.
13. Wheatland Tube; Zekelman Industries.

B. General Requirements for Metal Conduits and Fittings:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Comply with TIA-569-B.

C. GRC: Comply with ANSI C80.1 and UL 6.
D. ARC: Comply with ANSI C80.5 and UL 6A.
E. IMC: Comply with ANSI C80.6 and UL 1242.
F. PVC-Coated Steel Conduit: PVC-coated rigid steel conduit

1. Comply with NEMA RN 1.
2. Coating Thickness: 0.040 inch (1 mm), minimum.

G. EMT: Comply with ANSI C80.3 and UL 797.
H. FMC: Comply with UL 1; zinc-coated steel.
I. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.
J. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.

1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886 and NFPA 70.
2. Fittings for EMT:

a. Material: Steel
b. Type: compression.

3. Expansion Fittings: PVC or steel to match conduit type, complying with UL 467, rated for environmental conditions where installed, and including flexible external bonding jumper.
4. Coating for Fittings for PVC-Coated Conduit: Minimum thickness of 0.040 inch (1 mm), with overlapping sleeves protecting threaded joints.

K. Joint Compound for IMC, GRC, or ARC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

2.2 NONMETALLIC CONDUITS, TUBING, AND FITTINGS

A. Available Manufacturers meeting the following requirements.
B. General Requirements for Nonmetallic Conduits and Fittings:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Comply with TIA-569-B.

C. ENT: Comply with NEMA TC 13 and UL 1653.
D. RNC: Type EPC-40-PVC, complying with NEMA TC 2 and UL 651 unless otherwise indicated.
E. LFNC: Comply with UL 1660.
F. Rigid HDPE: Comply with UL 651A.
G. Continuous HDPE: Comply with UL 651B.
H. RTRC: Comply with UL 1684A and NEMA TC 14.
I. Fittings for ENT and RNC: Comply with NEMA TC 3; match to conduit or tubing type and material.
J. Fittings for LFNC: Comply with UL 514B.
K. Solvents and Adhesives: As recommended by conduit manufacturer.

2.3 METAL WIREWAYS AND AUXILIARY GUTTERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include.
B. Description: Sheet metal, complying with UL 870 and NEMA 250, Type 12 unless otherwise indicated, and sized according to NFPA 70.

1. Metal wireways installed outdoors shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Comply with TIA-569-B.

C. Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.
D. Wireway Covers: Hinged type unless otherwise indicated.
E. Finish: Manufacturer's standard enamel finish.

2.4 SURFACE PATHWAYS

A. General Requirements for Surface Pathways:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Comply with TIA-569-B.

B. Surface Metal Pathways: Galvanized steel with snap-on covers complying with UL 5. Manufacturer's standard enamel finish in color selected by Architect.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. MonoSystems, Inc.
b. Niedax Inc.
c. Panduit Corp.
d. Wiremold; Legrand North America, LLC.

C. Surface Nonmetallic Pathways: Two- or three-piece construction, complying with UL 5A, and manufactured of rigid PVC with texture and color selected by Architect from manufacturer's standard colors. Product shall comply with UL 94 V-0 requirements for self-extinguishing characteristics.

2.5 BOXES, ENCLOSURES, AND CABINETS

A. General Requirements for Boxes, Enclosures, and Cabinets:

1. Comply with TIA-569-B.
2. Boxes, enclosures and cabinets installed in wet locations shall be listed for use in wet locations.

B. Sheet-Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.
C. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, ferrous alloy, Type FD, with gasketed cover.
D. Box extensions used to accommodate new building finishes shall be of same material as recessed box.
E. Metal Floor Boxes:

1. Material: Cast metal or sheet metal.
2. Type: Fully adjustable.
3. Shape: Rectangular.
4. Listing and Labeling: Metal floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

F. Nonmetallic Floor Boxes: Nonadjustable, round.

1. Listing and Labeling: Nonmetallic floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

G. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
H. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, cast aluminum with gasketed cover.
I. Device Box Dimensions: 4 inches by 2-1/8 inches by 2-1/8 inches deep.
J. Gangable boxes are prohibited.
K. Nonmetallic Outlet and Device Boxes: Comply with NEMA OS 2 and UL 514C.
L. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 12 with continuous-hinge cover with flush latch unless otherwise indicated.

1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
2. Nonmetallic Enclosures:

a. Material: Plastic

3. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.

M. Cabinets:

1. NEMA 250, Type 12, galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
2. Hinged door in front cover with flush latch and concealed hinge.
3. Key latch to match panelboards.
4. Metal barriers to separate wiring of different systems and voltage.
5. Accessory feet where required for freestanding equipment.
6. Nonmetallic cabinets shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

PART 3 - EXECUTION

3.1 PATHWAY APPLICATION

A. Outdoors: Apply pathway products as specified below unless otherwise indicated:

1. Exposed Conduit: RNC.
2. Concealed Conduit, Aboveground: EMT.
3. Underground Conduit: RNC, Type EPC-40-PVC.
4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
5. Boxes and Enclosures, Aboveground: NEMA 250, Type 4X.

B. Indoors: Apply pathway products as specified below unless otherwise indicated:

1. Exposed, Not Subject to Physical Damage: EMT
2. Exposed, Not Subject to Severe Physical Damage: EMT
3. Exposed and Subject to Severe Physical Damage: GRC
4. Pathway locations include the following:

    a. Loading dock.
    b. Parking Areas
    c. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
    d. Mechanical rooms.

5. Concealed in Ceilings and Interior Walls and Partitions: EMT
6. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric-Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
7. Damp or Wet Locations: GRC
8. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4 stainless steel in institutional and commercial kitchens and damp or wet locations.

C. Minimum Pathway Size: 3/4-inch trade size.
D. Pathway Fittings: Compatible with pathways and suitable for use and location.

1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with this type of conduit. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.
3. EMT: Use compression], steel fittings. Comply with NEMA FB 2.10.

4. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.

E. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.
F. Install surface pathways only where indicated on Drawings.
G. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F.

3.2 INSTALLATION

A. Comply with NECA 1, NECA 101, and TIA-569-B for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum pathways. Comply with NFPA 70 limitations for types of pathways allowed in specific occupancies and number of floors.
B. Keep pathways at least 6 inches (150 mm) away from parallel runs of flues and steam or hot-water pipes. Install horizontal pathway runs above water and steam piping.
C. Complete pathway installation before starting conductor installation.
D. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for hangers and supports.
E. Arrange stub-ups so curved portions of bends are not visible above finished slab.
F. Install no more than the equivalent of three 90-degree bends in any conduit run except for communications wiring conduits for which only two 90-degree bends are allowed. Support within 12 inches (300 mm) of changes in direction.
G. Conceal conduit and EMT within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
H. Support conduit within 12 inches (300 mm) of enclosures to which attached.
I. Pathways Embedded in Slabs:

1. Run conduit larger than 1-inch (27-mm) trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support. Secure pathways to reinforcement at maximum 10-foot (3-m) intervals.
2. Arrange pathways to cross building expansion joints at right angles with expansion fittings.
3. Arrange pathways to keep a minimum of 2 inches of concrete cover in all directions.
4. Do not embed threadless fittings in concrete unless specifically approved by Architect for each specific location.
5. Change from ENT to [RNC, Type EPC-40-PVC] [GRC] [or] [IMC] before rising above floor.

J. Stub-ups to Above Recessed Ceilings:

1. Use EMT, IMC, or RMC for pathways.
2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.

K. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of pathway and fittings before making up joints. Follow compound manufacturer's written instructions.
L. Coat field-cut threads on PVC-coated pathway with a corrosion-preventing conductive compound prior to assembly.
M. Install pathways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.
N. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to conduit assembly to assure a continuous ground path.
O. Cut conduit perpendicular to the length. For conduits of 2-inch (53-mm) trade size and larger, use roll cutter or a guide to ensure cut is straight and perpendicular to the length.
P. Install pull wires in empty pathways. Use polypropylene or monofilament plastic line with not less than 200-lb (90-kg) tensile strength. Leave at least 12 inches (300 mm) of slack at each

end of pull wire. Cap underground pathways designated as spare above grade alongside pathways in use.

Q. Surface Pathways:

1. Install surface pathway for surface electrical outlet boxes only where indicated on Drawings.
2. Install surface pathway with a minimum 2-inch (50-mm) radius control at bend points.
3. Secure surface pathway with screws or other anchor-type devices at intervals not exceeding 48 inches (1200 mm) and with no less than two supports per straight pathway section. Support surface pathway according to manufacturer's written instructions. Tape and glue are not acceptable support methods.

R. Install pathway sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed pathways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install pathway sealing fittings according to NFPA 70.

S. Install devices to seal pathway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all pathways at the following points:

1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
2. Where an underground service pathway enters a building or structure.
3. Where otherwise required by NFPA 70.

T. Comply with manufacturer's written instructions for solvent welding PVC conduit and fittings.

U. Expansion-Joint Fittings:

1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed 30 deg F (17 deg C), and that has straight-run length that exceeds 25 feet (7.6 m). Install in each run of aboveground RMC and EMT conduit that is located where environmental temperature change may exceed 100 deg F (55 deg C) and that has straight-run length that exceeds 100 feet (30 m).
2. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:

    a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F temperature change.
    b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F temperature change.
    c. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F temperature change.
    d. Attics: 135 deg F temperature change.

3. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F (0.06 mm per meter of length of straight run per deg C) of temperature change for PVC conduits. Install fitting(s) that provide expansion and contraction for at least 0.000078 inch per foot of length of straight run per deg F (0.0115 mm per meter of length of straight run per deg C) of temperature change for metal conduits.
4. Install expansion fittings at all locations where conduits cross building or structure expansion joints.
5. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.

V. Flexible Conduit Connections: Comply with NEMA RV 3. Use maximum of 72 inches (1830 mm) of flexible conduit for recessed and semirecessed luminaires, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.

1. Use LFMC in damp or wet locations subject to severe physical damage.
2. Use LFMC or LFNC in damp or wet locations not subject to severe physical damage.

W. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to [center] [top] [bottom] of box unless otherwise indicated.
X. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surface to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box.
Y. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.
Z. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.
AA. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.
BB. Set metal floor boxes level and flush with finished floor surface.
CC. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

3.3 INSTALLATION OF UNDERGROUND CONDUIT

A. Direct-Buried Conduit:

1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom as specified in Section 312000 "Earth Moving" for pipe less than 6 inches (150 mm) in nominal diameter.
2. Install backfill as specified in Section 312000 "Earth Moving."
3. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches (300 mm) of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified in Section 312000 "Earth Moving."
4. Install manufactured duct elbows for stub-ups at poles and equipment and at building entrances through floor unless otherwise indicated. Encase elbows for stub-up ducts throughout the length of elbow.

    a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches (75 mm) of concrete for a minimum of 12 inches (300 mm) on each side of the coupling..

5. Underground Warning Tape: Comply with requirements in Section 260553 "Identification for Electrical Systems."

3.4 INSTALLATION OF UNDERGROUND HANDHOLES AND BOXES

A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting conduits to minimize bends and deflections required for proper entrances.
B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch (12.5-mm) sieve to No. 4 (4.75-mm) sieve and compacted to same density as adjacent undisturbed earth.
C. Elevation: In paved areas, set so cover surface will be flush with finished grade. Set covers of other enclosures 1 inch (25 mm) above finished grade.
D. Install handholes with bottom below frost line, Insert depth of frost line below grade at Project site below grade.
E. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated. Select arm lengths to be long enough to provide spare space for future cables, but short enough to preserve adequate working clearances in enclosure.

F. Field cut openings for conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

3.5 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRONIC SAFETY AND SECURITY PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electronic Safety and Security Pathways and Cabling."

3.6 FIRESTOPPING

A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.7 PROTECTION

A. Protect coatings, finishes, and cabinets from damage and deterioration.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION

This page is intentionally left blank.

SECTION 28 05 29 - HANGERS AND SUPPORTS FOR SECURITY SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Steel slotted support systems for communication raceways.
2. Aluminum slotted support systems for communication raceways.
3. Nonmetallic slotted support systems for communication raceways.
4. Conduit and cable support devices.
5. Support for conductors in vertical conduit.
6. Structural steel for fabricated supports and restraints.
7. Mounting, anchoring, and attachment components, including powder-actuated fasteners, mechanical expansion anchors, concrete inserts, clamps, through bolts, toggle bolts, and hanger rods.
8. Fabricated metal equipment support assemblies.

B. Related Requirements:

1. Section 270548 "Seismic Controls for Communications Systems" for products and installation requirements necessary for compliance with seismic criteria.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for the following:

a. Slotted support systems, hardware, and accessories.
b. Clamps.
c. Hangers.
d. Sockets.
e. Eye nuts.
f. Fasteners.
g. Anchors.
h. Saddles.
i. Brackets.

2. Include rated capacities and furnished specialties and accessories.

B. Shop Drawings: Signed and sealed by a qualified professional engineer. For fabrication and installation details for communications hangers and support systems.

1. Trapeze hangers. Include product data for components.
2. Steel slotted-channel systems.
3. Aluminum slotted-channel systems.
4. Nonmetallic slotted-channel systems.
5. Equipment supports.

6. Vibration Isolation Base Details: Detail fabrication, including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.

C. Delegated-Design Submittal: For hangers and supports for communications systems.

1. Include design calculations and details of trapeze hangers.
2. Include design calculations for seismic restraints.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Suspended ceiling components.
2. Ductwork, piping, fittings, and supports.
3. Structural members to which hangers and supports will be attached.
4. Size and location of initial access modules for acoustical tile.
5. Items penetrating finished ceiling, including the following:

a. Luminaires.
b. Air outlets and inlets.
c. Speakers.
d. Sprinklers.
e. Access panels.
f. Projectors.
g. Telecom Outlets.

B. Seismic Qualification Data: Certificates, for hangers and supports for communications equipment and systems, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. Welding certificates.

1.5 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M] [AWS D1.2/D1.2M].
B. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M.
2. AWS D1.2/D1.2M.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design hanger and support system.

B. Seismic Performance: Hangers and supports shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. The term "withstand" means "the supported equipment and systems will remain in place without separation of any parts when subjected to the seismic forces specified and the system will be fully operational after the seismic event."
2. Component Importance Factor: 1.5

C. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame Rating: Class 1.
2. Self-extinguishing according to ASTM D635.

2.2 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Steel Slotted Support Systems: Preformed steel channels and angles with minimum 13/32-inch- (10-mm-) diameter holes at a maximum of 8 inches (200 mm) o.c. in at least one surface.

1. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
2. Material for Channel, Fittings, and Accessories: Galvanized steel.
3. Channel Width: Selected for applicable load criteria
4. One of the Following Finishes;

    a. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
    b. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
    c. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.

5. Channel Dimensions: Selected for applicable load criteria.

B. Aluminum Slotted Support Systems: Extruded aluminum channels and angles with minimum 13/32-inch- (10-mm-) diameter holes at a maximum of 8 inches (200 mm) o.c. in at least one surface.

1. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
2. Channel Material: 6063-T6 aluminum alloy.
3. Fittings and Accessories Material: 5052-H32 aluminum alloy.
4. Channel Width: Selected for applicable load criteria.
5. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
6. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
7. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
8. Channel Dimensions: Selected for applicable load criteria.

C. Nonmetallic Slotted Support Systems: Structural-grade, factory-formed, glass-fiber-resin channels and angles with minimum 13/32-inch- (10-mm-) diameter holes at a maximum of 8 inches (200 mm) o.c., in at least one surface.

1. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
2. Channel Width: Selected for applicable load criteria
3. Fittings and Accessories: Products provided by channel and angle manufacturer and designed for use with those items.

4. Fitting and Accessory Materials: Same as those for channels and angles, except metal items may be stainless steel.
5. Rated Strength: Selected to suit applicable load criteria.
6. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

D. Conduit and Cable Support Devices: Steel and malleable-iron clamps, hangers, and associated fittings, designed for types and sizes of raceway or cable to be supported.
E. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for nonarmored communications conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be made of malleable iron.
F. Structural Steel for Fabricated Supports and Restraints: ASTM A36/A36M steel plates, shapes, and bars; black and galvanized.
G. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:

1. Powder-Actuated Fasteners: Threaded-steel stud for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
2. Mechanical-Expansion Anchors: Insert-wedge-type zinc-coated steel for use in hardened portland cement concrete, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
3. Concrete Inserts: Steel or malleable-iron, slotted support system units are similar to MSS Type 18 units and comply with MFMA-4 or MSS SP-58.
4. Clamps for Attachment to Steel Structural Elements: MSS SP-58 units are suitable for attached structural element.
5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM F3125/F3125M,Grade A325 (Grade A325M).
6. Toggle Bolts: All-steel springhead type.
7. Hanger Rods: Threaded steel.

2.3 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

A. Description: Welded or bolted structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.
B. Materials: Comply with requirements in Section 055000 "Metal Fabrications" for steel shapes and plates.

PART 3 - EXECUTION

3.1 APPLICATION

A. Comply with the following standards for application and installation requirements of hangers and supports, except where requirements on Drawings or in this Section are stricter:

1. NECA 1.
2. NECA/BICSI 568.
3. TIA-569-D.
4. NECA 101.
5. NECA 105.

B. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping materials and installation for penetrations through fire-rated walls, ceilings, and assemblies.
C. Comply with requirements for pathways specified in Section 270528 "Pathways for Communications Systems."

D. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMTs, IMCs, and RMCs as scheduled in NECA 1, where its Table 1 lists maximum spacings that are less than those stated in NFPA 70. Minimum rod size shall be 1/4 inch (6 mm) in diameter.

E. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted or other support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.

1. Secure raceways and cables to these supports with two-bolt conduit clamps.

F. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch (38-mm) and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.

3.2 SUPPORT INSTALLATION

A. Raceway Support Methods: In addition to methods described in NECA 1, EMT may be supported by openings through structure members, according to NFPA 70.

B. Strength of Support Assemblies: Where not indicated, select sizes of components, so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb (90 kg).

C. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten communications items and their supports to building structural elements by the following methods unless otherwise indicated by code:

1. To Wood: Fasten with lag screws or through bolts.
2. To New Concrete: Bolt to concrete inserts.
3. To Masonry: Use approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
4. To Existing Concrete: Use expansion anchor fasteners.
5. Instead of expansion anchors, powder-actuated-driven threaded studs, provided with lock washers and nuts, may be used in existing standard-weight concrete 4 inches (100 mm) thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches (100 mm) thick.
6. To Steel: Beam clamps (MSS SP-58, Type 19, 21, 23, 25, or 27), complying with MSS SP-69Spring-tension clamps.
7. To Light Steel: Sheet metal screws.
8. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate by means that comply with seismic-restraint strength and anchorage requirements.

D. Drill holes for expansion anchors in concrete at locations and to depths that avoid the need for reinforcing bars.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

A. Comply with installation requirements in Section 055000 "Metal Fabrications" for site-fabricated metal supports.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor communications materials and equipment.

C. Field Welding: Comply with AWS D1.1/D1.1M.

3.4 PAINTING

A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils (0.05 mm).

B. Touchup: Comply with requirements in painting Sections for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas, and apply galvanizing-repair paint to comply with ASTM A780.

END OF SECTION

SECTION 28 05 31.10- COMMUNICATIONS EQUIPMENT FOR ELECTRONIC SECURITY

PART 1 - GENERAL

1.1 SYSTEM DESCRIPTION

A. This specification is for the communications equipment directly supporting the electronic security systems (ESS).

1.2 SUMMARY

A. This Section includes the following:

1. Network Switches
2. Fiber Switches

1.3 REFER TO 280500.10 FOR ALL OTHER PART I REQUIREMENTS

PART 2 - PRODUCTS

2.1 NETWORK SWITCH

A. Acceptable Manufacturers

1. Juniper
2. Approved Equals

B. EX4300-48P – switch

C. EX-UM-4X4SFP – SFP uplink module

D. JPSU-1100-AC-AFO – power supply for switch

E. EX-SFP-1GE-SX- SFP

F. CBL-PWR-C15M-HITEMP - power cord

2.2 FIELD ENCLOSURE

A. Hardened Network Switch

1. Comnet Environmentally Hardened Layer 2 Switch with 2 SFP/4 Electrical Posts with POE Power
2. Model: CHGE2FE4SMSPOEHO
3. Provide Required SFP Modules for both IDF and Field Side connections.

B. Hardened RS485 Transceiver

1. Comnet Environmentally Hardened RS 485 Transceiver
2. Model: FDX2HSDEA-M (INCLUDE FDX2HSDE B-M AT TELECOM CLOSET side)

C. Power Supply

1. Comnet Power Supplies, Hardwired
2. PS48VDC-5A, Model: PS-DRA240-48A, AND
3. PS24VDC-0.72A, Model: PSAMR1-24: 1.35 / 0.72
4. Din Rail: 35 MM

PART 3 - EXECUTION

3.1 GROUNDING

A. Comply with requirements in Section 270526.10 "Grounding and Bonding for Security Systems" for grounding conductors and connectors.

3.2 IP ADDRESSING

A. Refer to 280500.10 Submittals for requirements.

3.3 REFER TO 280500.10 FOR ALL OTHER PART III REQUIREMENTS

END OF SECTION

SECTION 28 05 43 - UNDERGROUND PATHWAYS FOR SECURITY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Metal conduit and fittings, including GRC and PVC-coated GRC.
2. Rigid nonmetallic duct.
3. Flexible nonmetallic duct.
4. Duct accessories, including rigid innerduct and fabric innerduct.
5. Precast concrete handholes.
6. Polymer concrete handholes and boxes with polymer concrete cover.
7. Fiberglass handholes and boxes with polymer concrete cover.
8. Fiberglass handholes and boxes.
9. High density plastic boxes.
10. Utility structure accessories.

1.2 DEFINITIONS

A. Direct-Buried: Duct or a duct bank that is buried in the ground, without any additional casing materials, such as concrete.

B. Duct: A single duct or multiple ducts. Duct may be either installed singly or as component of a duct bank.

C. Duct Bank:

1. Two or more ducts installed in parallel, with or without additional casing materials.
2. Multiple duct banks.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings:

1. Precast or Factory-Fabricated Underground Utility Structures:

a. Include plans, elevations, sections, details, attachments to other work, and accessories.
b. Include duct entry provisions, including location and duct size.
c. Include reinforcement details.
d. Include frame and cover design and manhole chimneys.
e. Include [ladder] [step] details.
f. Include grounding details.
g. Include dimensioned locations of cable rack inserts, pulling-in and lifting irons, and sumps.
h. Include joint details.

2. Factory-Fabricated Handholes and Boxes Other Than Precast Concrete:

    a. Include dimensioned plans, sections, and elevations, and fabrication and installation details.
    b. Include duct entry provisions, including location and duct size.
    c. Include cover design.
    d. Include grounding details.
    e. Include dimensioned locations of cable rack inserts, and pulling-in and lifting irons.

1.4 INFORMATIONAL SUBMITTALS

A. Duct and Duct-Bank Coordination Drawings: Show duct profiles and coordination with other utilities and underground structures.

1. Drawings shall be signed and sealed by a qualified professional engineer.

B. Product Certificates: For concrete and steel used in precast concrete handholes, as required by ASTM C 858.

C. Qualification Data: For professional engineer and testing agency responsible for testing nonconcrete handholes and boxes.

D. Source quality-control reports.

E. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to ASTM E 329 for testing indicated.

PART 2 - PRODUCTS

2.1 RIGID NONMETALLIC DUCT

A. Underground Plastic Utilities Duct: Type EPC-80-PVC RNC, complying with NEMA TC 2 and UL 651, with matching fittings complying with NEMA TC 3 by same manufacturer as duct.

B. General Requirements for Nonmetallic Ducts and Fittings:

1. Listed and labeled as defined in NFPA 70, by a nationally recognized testing laboratory, and marked for intended location and application.
2. Comply with TIA-569-C and TIA-758-C.

C. Solvents and Adhesives: As recommended by duct manufacturer.

2.2 FLEXIBLE NONMETALLIC DUCT

A. HDPE Duct: Type EPEC 80-HDPE complying with NEMA TC 7 and UL 651A.

B. General Requirements for HDPE Duct

1. Listed and labeled as defined in NFPA 70, by a nationally recognized testing laboratory, and marked for intended location and application.
2. Comply with TIA-569-C and TIA-758-C.

2.3 DUCT ACCESSORIES

A. Fabric Innerduct: Continuous, polyester, multi -pocket fabric innerduct, with internal pull tape and tracer wire.

B. Underground-Line Warning Tape: Underground-line warning tape specified in Section 270553 "Identification for Communications Systems."

2.4 PRECAST CONCRETE HANDHOLES AND BOXES

A. Description: Monolithically poured, factory-fabricated, reinforced-concrete walls and bottom unless open-bottom enclosures are indicated. Frame and cover shall form top of enclosure and shall have load rating consistent with that of handhole or box.

B. Comply with ASTM C 858 for design and manufacturing processes.

C. Frame and Cover: Weatherproof cast-iron frame, with cast-iron cover with recessed cover hook eyes and tamper-resistant, captive, cover-securing bolts.

D. Frame and Cover: Weatherproof steel frame, with steel cover with recessed cover hook eyes and tamper-resistant, captive, cover-securing bolts.

E. Frame and Cover: Weatherproof steel frame, with hinged steel access door assembly with tamper-resistant, captive, cover-securing bolts.

1. Cover Hinges: Concealed, with hold-open ratchet assembly.
2. Cover Handle: Recessed.

F. Frame and Cover: Weatherproof aluminum frame, with hinged aluminum access door assembly with tamper-resistant, captive, cover-securing bolts.

1. Cover Hinges: Concealed, with hold-open ratchet assembly.
2. Cover Handle: Recessed.

G. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.

H. Cover Legend: Molded lettering, “COMM."

I. Configuration: Units shall be designed for flush burial and have open bottom unless otherwise indicated.

J. Extensions and Slabs: Designed to mate with bottom of enclosure, and made of same material as enclosure.

1. Extension shall provide increased depth of 12 inches (300 mm)
2. Slab: Same dimensions as bottom of enclosure, and arranged to provide closure.

K. Joint Sealant: Asphaltic-butyl material with adhesion, cohesion, flexibility, and durability properties necessary to withstand maximum hydrostatic pressures at the installation location with the ground-water level at grade.

L. Knockout Panels: Precast openings in walls, arranged to match dimensions and elevations of approaching duct and duct banks, plus an additional 6 inches (150 mm vertically and horizontally to accommodate alignment variations.

1. Knockout panels shall be located no less than 6 inches (150 mm) from interior surfaces of walls, floors, or frames and covers of handholes, but close enough to corners to facilitate racking of cables on walls.
2. Knockout panel opening shall have cast-in-place, welded-wire fabric reinforcement for field cutting and bending to tie in to concrete envelopes of duct banks.
3. Knockout panel openings shall be framed with at least two additional No. 3 steel reinforcing bars in concrete around each opening.
4. Knockout panels shall be 1-1/2 to 2 inches (38 to 50 mm) thick.

M. Duct Entrances in Handhole Walls: Cast end-bell or duct-terminating fitting in wall for each entering duct.

1. Type and size shall match fittings to duct or conduit to be terminated.
2. Fittings shall align with elevations of approaching duct and be located near interior corners of handholes to facilitate racking of cable.

N. Handholes 12 inches wide by 24 inches long (300 mm wide by 600 mm long) and larger shall have inserts for cable racks and pulling-in irons installed before concrete is poured.

PART 3 - EXECUTION

3.1 PREPARATION

A. Coordinate layout and installation of duct, duct bank, manholes, handholes, and boxes with final arrangement of other utilities, site grading, and surface features as determined in the field. Notify Architect if there is a conflict between areas of excavation and existing structures or archaeological sites to remain.

B. Coordinate elevations of duct and duct-bank entrances into manholes, handholes, and boxes with final locations and profiles of duct and duct banks, as determined by coordination with other utilities, underground obstructions, and surface features. Revise locations and elevations as required to suit field conditions and to ensure that duct runs drain to manholes and handholes, and as approved by Architect.

3.2 UNDERGROUND DUCT APPLICATION

A. Duct for Communications: Type EPC-80-PVC RNC, in direct-buried duct bank unless otherwise indicated.

B. Duct for Communications: Type EPEC-80-HDPE duct in direct-bored duct bank unless otherwise indicated.

C. Underground Duct Crossing Paved Paths, Walks and Driveways: Type EPC-40-PVC RNC, encased in reinforced concrete.

D. Stub-Ups for Communications: Concrete-encased RNC.

3.3 UNDERGROUND ENCLOSURE APPLICATION

A. Handholes and Boxes for Communications:

1. Units in Roadways and Other Deliberate Traffic Paths: Precast concrete. AASHTO HB 17, H-10 structural load rating.
2. Units in Driveway, Parking Lot, and Off-Roadway Locations, Subject to Occasional, Nondeliberate Loading by Heavy Vehicles: Precast concrete, AASHTO HB 17, H-20 Polymer concrete, SCTE 77, Tier 15 structural load rating.
3. Units in Sidewalk and Similar Applications with a Safety Factor for Nondeliberate Loading by Vehicles: Precast concrete, AASHTO HB 17, H-5, Polymer concrete units, SCTE 77, Tier 8 structural load rating.
4. Units Subject to Light-Duty Pedestrian Traffic Only: Fiberglass-reinforced polyester resin, structurally tested according to SCTE 77 with 3000-lbf (13 345-N) vertical loading.
5. Cover design load shall not exceed the design load of the handhole or box.

B. Manholes: Precast concrete.

1. Units Located in Roadways and Other Deliberate Traffic Paths by Heavy or Medium Vehicles: H-20 structural load rating according to AASHTO HB 17.
2. Units Not Located in Deliberate Traffic Paths by Heavy or Medium Vehicles: H-10 load rating according to AASHTO HB 17.

3.4 EARTHWORK

A. Excavation and Backfill: Comply with Section 312000 "Earth Moving," but do not use heavy-duty, hydraulic-operated, compaction equipment.

B. Restoration: Replace area immediately after backfilling is completed.

C. Restore surface features at areas disturbed by excavation, and re-establish original grades unless otherwise indicated.

D. Restore areas disturbed by trenching, storing of dirt, cable laying, and other work. Restore vegetation and include necessary topsoiling, fertilizing, liming, seeding, sodding, sprigging, and mulching. Comply with Section 329200 "Turf and Grasses" and Section 329300 "Plants."

E. Cut and patch existing pavement in the path of underground duct, duct bank, and utility structures according to the "Cutting and Patching" Article in Section 017300 "Execution."

3.5 DUCT AND DUCT-BANK INSTALLATION

A. Where indicated on Drawings, install duct, spacers, and accessories into the duct configuration shown. Duct installation requirements in this Section also apply to duct bank.

B. Install duct and duct bank according to NEMA TCB 2 and TIA-758-C.

C. Slope: Pitch duct and duct bank a minimum slope of 1:100 down toward manholes and handholes and away from buildings and equipment. Slope duct and duct bank from a high point in runs between two manholes, to drain in both directions.

D. Curves and Bends: Use 5-degree angle couplings for small changes in direction. Use manufactured long sweep bends with a minimum radius of 48 inches (1200 mm) both horizontally and vertically, at other locations unless otherwise indicated.

1. Duct and duct banks shall have maximum of two 90-degree bends, or the total of all bends shall be no more 180 degrees between pull points.

E. Joints: Use solvent-cemented joints in duct and fittings, and make watertight according to manufacturer's written instructions. Stagger couplings, so those of adjacent ducts do not lie in same plane.

F. Installation Adjacent to High-Temperature Steam Lines: Where duct or duct banks are installed parallel to underground steam lines, perform calculations showing the duct or duct bank will not be subject to environmental temperatures above 40 deg C. Where environmental temperatures are calculated to rise above 40 deg C, and anywhere the duct or duct bank crosses above an underground steam line, install insulation blankets listed for direct burial to isolate the duct bank from the steam line.

G. End-Bell Entrances to Manholes and Concrete and Polymer Concrete Handholes: Use end bells, spaced approximately 6 inches (150 mm) o.c. for 4-inch (100-mm) duct, and vary proportionately for other duct sizes.

H. Terminator Entrances to Manholes and Concrete and Polymer Concrete Handholes: Use manufactured, cast-in-place duct terminators, with entrances into structure spaced approximately 6 inches (150 mm) o.c. for 4-inch (100-mm) duct, and vary proportionately for other duct sizes.

I. Building Wall Penetrations: Make a transition from underground duct to GRC at least 10 feet (3 m) outside the building wall, without reducing duct slope away from the building or forming a trap in the duct. Use fittings manufactured for RNC duct-to-GRC conduit transition. Install GRC penetrations of building walls as specified in Section 270544 "Sleeves and Sleeve Seals for Communications Pathways and Cabling."

J. Sealing: Provide temporary closure at terminations of duct that has cables pulled. Seal spare ducts at terminations. Use sealing compound and plugs to withstand at least 15-psig (1.03-MPa) hydrostatic pressure.

K. Innerduct: Install immediately after mandreling duct. Size and type as indicated on Drawings.

L. Pulling Cord: Install 200-lbf- (1000-N-m) test nylon cord in empty duct [and innerduct].

M. Concrete-Encased Duct and Duct Bank:

1. Excavate trench bottom to provide firm and uniform support for duct or duct bank. Prepare trench bottoms as specified in Section 312000 "Earth Moving" for pipes less than 6 inches (150 mm) in nominal diameter.
2. Width: Excavate trench 12 inches (300 mm) wider than duct or duct bank on each side.
3. Width: Excavate trench 3 inches (75 mm) wider than duct or duct bank on each side.
4. Depth: Install top of duct and duct bank at least 24 inches (600 mm) below finished grade in areas not subject to deliberate traffic, and at least 30 inches (750 mm) below finished grade in deliberate traffic paths for vehicles unless otherwise indicated.
5. Support duct and duct bank on duct spacers coordinated with duct size, duct spacing, and outdoor temperature.

6. Minimum Space Between Duct: 3 inches (75 mm) between edge of duct and exterior envelope wall, 2 inches (50 mm) between ducts for like services, and 4 inches (100 mm) between power and communications ducts.
7. Spacer Installation: Place spacers close enough to prevent sagging and deforming of duct, with not less than [four] [five] spacers per 20 feet (6 m) of duct. Place spacers within 24 inches (600 mm) of duct ends. Stagger spacers approximately 6 inches (150 mm) between tiers. Secure spacers to earth and duct to prevent floating during concreting. Tie entire assembly together using fabric straps; do not use tie wires or reinforcing steel that may form conductive or magnetic loops around duct or duct bank.
8. Elbows: Use manufactured duct elbows for stub-ups, at building entrances, and at changes of direction in duct run unless otherwise indicated. Extend concrete encasement throughout length of elbow.
9. Elbows: Use manufactured GRC elbows for stub-ups, at building entrances, and at changes of direction in duct run.
10. Reinforcement: Reinforce concrete-encased duct and duct bank where they cross disturbed earth and where indicated. Arrange reinforcing rods and ties without forming conductive or magnetic loops around ducts or duct groups.
11. Forms: Use trench walls to form side walls of duct and duct bank where soil is self-supporting and concrete envelope can be poured without soil inclusions; otherwise, use forms.
12. Concrete Cover: Install a minimum of 3 inches (75 mm) of concrete cover between edge of duct to exterior envelope wall, 2 inches (50 mm) between ducts, and 4 inches (100 mm) between power and communications duct.
13. Concreting Sequence: Pour each run of envelope between manholes or other terminations in one continuous operation.
14. Pouring Concrete: Comply with requirements in "Concrete Placement" Article in Section 033000 "Cast-in-Place Concrete." Place concrete carefully during pours to prevent voids under and between ducts and at exterior surface of envelope. Do not allow a heavy mass of concrete to fall directly onto duct. Allow concrete to flow to center of bank and rise up in middle, uniformly filling all open spaces. Do not use power-driven agitating equipment unless specifically designed for duct-bank application.

N. Direct-Buried Duct and Duct Banks:

1. Excavate trench bottom to provide firm and uniform support for duct and duct bank. Comply with requirements in Section 312000 "Earth Moving" for preparation of trench bottoms for duct less than 6 inches (150 mm) in nominal diameter.
2. Install duct with a minimum of 3 inches (75 mm) between duct for like services and 6 inches (150 mm) between power and signal duct.
3. Width: Excavate trench 12 inches (300 mm) wider than duct or duct bank on each side.
4. Width: Excavate trench 3 inches (75 mm) wider than duct or duct bank on each side.
5. Depth: Install top of duct or duct bank at least 36 inches (900 mm) below finished grade unless otherwise indicated.
6. Set elevation of bottom of duct or duct bank below frost line.
7. Support duct on duct spacers coordinated with duct size, duct spacing, and outdoor temperature.
8. Spacer Installation: Place spacers close enough to prevent sagging and deforming of duct, with not less than [four] [five] spacers per 20 feet (6 m) of duct. Place spacers within 24 inches (600 mm) of duct ends. Stagger spacers approximately 6 inches (150 mm) between tiers. Secure spacers to earth and duct to prevent floating during concreting. Tie entire assembly together using fabric straps; do not use tie wires or reinforcing steel that may form conductive or magnetic loops around duct or duct bank.
9. Elbows: Install manufactured duct elbows for stub-ups, at building entrances through floor, and at changes of direction in duct unless otherwise indicated. Encase elbows for stub-ups throughout length of elbow. [Extend encasement minimum of 36 inches (900 mm) beyond elbow joints].

10. After installing first tier of duct, backfill and compact. Start at tie-in point and work toward end of duct run, leaving duct at end of run free to move with expansion and contraction, as temperature changes during this process. Repeat procedure after placing each tier. After placing last tier, hand place backfill to 4 inches (100 mm) over duct and hand tamp. Firmly tamp backfill around duct to provide maximum supporting strength. Use hand tamper only. After placing controlled backfill over final tier, make final duct connections at end of run and complete backfilling with normal compaction. Comply with requirements in Section 312000 "Earth Moving" for installation of backfill materials.

O. Underground-Line Warning Tape: Bury [nonconducting] [conducting] underground-line warning tape specified in Section 270553 "Identification for Communication Systems" no less than 12 inches (300 mm) above all concrete-encased duct and duct bank [and approximately 12 inches (300 mm) below grade]. Align tape parallel to and within 3 inches (75 mm) of centerline of duct bank. Provide an additional warning tape for each 12-inch (300-mm) increment of duct-bank width over a nominal 18 inches (450 mm). Space additional tapes 12 inches (300 mm) apart, horizontally.

3.6 INSTALLATION OF CONCRETE MANHOLES, HANDHOLES, AND BOXES

A. Precast Concrete Handhole and Manhole Installation:

1. Comply with ASTM C 891 unless otherwise indicated.
2. Install units level and plumb and with orientation and depth coordinated with connecting duct, to minimize bends and deflections required for proper entrances.
3. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1-inch (25-mm) sieve to No. 4 (4.75-mm) sieve and compacted to same density as adjacent undisturbed earth.

B. Elevations:

1. Manhole Roof: Install with rooftop at least 15 inches (380 mm) below finished grade.
2. Manhole Frame: In paved areas and trafficways, set frames flush with finished grade. Set other manhole frames 1 inch (25 mm) above finished grade.
3. Install handholes with bottom below frost line, <Insert depth of frost line below grade at Project site> below grade.
4. Handhole Covers: In paved areas and trafficways, set surface flush with finished grade. Set covers of other handholes 1 inch (25 mm) above finished grade.
5. Where indicated, cast handhole cover frame integrally with handhole structure.

C. Drainage: Install drains in bottom of manholes where indicated. Coordinate with drainage provisions indicated.

D. Manhole Access: Circular opening in manhole roof; sized to match cover size.

1. Manholes with Fixed Ladders: Offset access opening from manhole centerlines to align with ladder.
2. Install chimney, constructed of precast concrete collars and rings, to support cast-iron frame to connect cover with manhole roof opening. Provide moisture-tight masonry joints and waterproof grouting for frame to chimney.

E. Waterproofing: Apply waterproofing to exterior surfaces of manholes[and handholes] after concrete has cured at least three days. Waterproofing materials and installation are specified in [Section 071353 "Elastomeric Sheet Waterproofing."] [Section 071354 "Thermoplastic Sheet Waterproofing."] <Insert waterproofing Section>. After duct has been connected and grouted,

and before backfilling, waterproof joints and connections, and touch up abrasions and scars. Waterproof exterior of manhole chimneys after mortar has cured at least three days.

F. Dampproofing: Apply dampproofing to exterior surfaces of manholes[and handholes] after concrete has cured at least three days. Dampproofing materials and installation are specified in Section 071113 "Bituminous Dampproofing." After duct has been connected and grouted, and before backfilling, dampproof joints and connections, and touch up abrasions and scars. Dampproof exterior of manhole chimneys after mortar has cured at least three days.

G. Hardware: Install removable hardware, including pulling eyes, cable stanchions, [and]cable arms, [and insulators,]as required for installation and support of cables and conductors and as indicated.

H. Fixed Manhole Ladders: Arrange to provide for safe entry with maximum clearance from cables and other items in manholes.

I. Field-Installed Bolting Anchors in Manholes and Concrete Handholes: Do not drill deeper than 3-7/8 inches (97 mm) for manholes and 2 inches (50 mm) for handholes, for field-installed anchor bolts installed. Use a minimum of two anchors for each cable stanchion.

3.7 GROUNDING

A. Ground underground duct, duct bank, and utility structures according to Section 270526 "Grounding and Bonding for Communications Systems."

3.8 FIELD QUALITY CONTROL

A. Perform the following tests and inspections and prepare test reports:

1. Demonstrate capability and compliance with requirements on completion of installation of underground duct, duct bank, and utility structures.
2. Pull solid aluminum or wood test mandrel through duct to prove joint integrity and adequate bend radii, and test for out-of-round duct. Provide a minimum 12-inch- (300-mm-) long mandrel equal to duct size minus 1/4 inch (6 mm). If obstructions are indicated, remove obstructions and retest.
3. Test manhole[and handhole] grounding to ensure electrical continuity of grounding and bonding connections. Measure and report ground resistance as specified in Section 270526 "Grounding and Bonding for Communications Systems."

B. Correct deficiencies and retest as specified above to demonstrate compliance.

3.9 CLEANING

A. Pull leather-washer-type duct cleaner, with graduated washer sizes, through full length of duct until duct cleaner indicates that duct is clear of dirt and debris.

B. Clean internal surfaces of manholes, including sump.

1. Sweep floor, removing dirt and debris.
2. Remove foreign material.

END OF SECTION 27 05 43

SECTION 28 05 44 - SLEEVES AND SLEEVE SEALS FOR ELECTRONIC SECURITY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Sleeves for pathway and cable penetration of non-fire-rated construction walls and floors.
2. Sleeve-seal systems.
3. Sleeve-seal fittings.
4. Grout.
5. Silicone sealants.

B. Related Requirements:

1. Section 078413 "Penetration Firestopping" for penetration firestopping installed in fire-resistance-rated walls, horizontal assemblies, and smoke barriers, with and without penetrating items.
2. penetration firestopping installed in fire-resistance-rated walls, horizontal assemblies, and smoke barriers, with and without penetrating items.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 SLEEVES

A. Wall Sleeves:

1. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, plain ends.
2. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.

B. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies: Galvanized-steel sheet; 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint, with tabs for screw-fastening the sleeve to the board.

C. PVC-Pipe Sleeves: ASTM D 1785, Schedule 40.
D. Molded-PVC Sleeves: With nailing flange for attaching to wooden forms.
E. Molded-PE or -PP Sleeves: Removable, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.
F. Sleeves for Rectangular Openings:

1. Material: Galvanized-steel sheet.
2. Minimum Metal Thickness:

a. For sleeve cross-section rectangle perimeter less than 50 inches (1270 mm) and with no side larger than 16 inches (400 mm), thickness shall be 0.052 inch (1.3 mm).
b. For sleeve cross-section rectangle perimeter 50 inches (1270 mm) or more and one or more sides larger than 16 inches (400 mm), thickness shall be 0.138 inch (3.5 mm).

2.2 SLEEVE-SEAL SYSTEMS

A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and pathway or cable.

1. Sealing Elements: EPDM rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
2. Pressure Plates: Stainless steel
3. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements.

2.3 SLEEVE-SEAL FITTINGS

A. Description: Manufactured plastic, sleeve-type, waterstop assembly made for embedding in concrete slab or wall. Unit shall have plastic or rubber waterstop collar with center opening to match piping OD.

2.4 GROUT

A. Description: Nonshrink; recommended for interior and exterior sealing openings in non-fire-rated walls or floors.
B. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
C. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.
D. Packaging: Premixed and factory packaged.

2.5 SILICONE SEALANTS

A. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below.

1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces that are not fire rated.

B. Silicone Foams: Multicomponent, silicone-based, liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION FOR NON-FIRE-RATED ELECTRICAL PENETRATIONS

A. Comply with NECA 1.
B. Comply with NEMA VE 2 for cable tray and cable penetrations.
C. Sleeves for Conduits Penetrating Above-Grade Non-Fire-Rated Concrete and Masonry-Unit Floors and Walls:

1. Interior Penetrations of Non-Fire-Rated Walls and Floors:

a. Seal annular space between sleeve and pathway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Section 079200 "Joint Sealants."
b. Seal space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect material while curing.

2. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
3. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and pathway or cable unless sleeve seal is to be installed or unless seismic criteria require different clearance.
4. Install sleeves for wall penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of walls. Cut sleeves to length for mounting flush with both surfaces of walls. Deburr after cutting.

5. Install sleeves for floor penetrations. Extend sleeves installed in floors 2 inches above finished floor level. Install sleeves during erection of floors.

D. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies:

1. Use circular metal sleeves unless penetration arrangement requires rectangular sleeved opening.
2. Seal space outside of sleeves with approved joint compound for gypsum board assemblies.

E. Roof-Penetration Sleeves: Seal penetration of individual pathways and cables with flexible boot-type flashing units applied in coordination with roofing work.
F. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.
G. Underground, Exterior-Wall and Floor Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch (25-mm) annular clear space between pathway or cable and sleeve for installing sleeve-seal system.

3.2 SLEEVE-SEAL-SYSTEM INSTALLATION

A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at pathway entries into building.
B. Install type and number of sealing elements recommended by manufacturer for pathway or cable material and size. Position pathway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pathway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.3 SLEEVE-SEAL-FITTING INSTALLATION

A. Install sleeve-seal fittings in new walls and slabs as they are constructed.
B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.
C. Secure nailing flanges to concrete forms.
D. Using grout, seal the space around outside of sleeve-seal fittings.

END OF SECTION

This page is intentionally left blank.

SECTION 28 08 00.10 - COMMISSIONING OF ELECTRONIC SECURITY

PART 1 - GENERAL

1.1 SYSTEM DESCRIPTION

A. This specification is for the commissioning of electronic security systems (ESS).

1.2 SUMMARY

A. This Section includes the following:

1. Commissioning of the Electronic Security Systems

1.3 REFER TO 280500.10 FOR ALL OTHER PART I REQUIREMENTS

PART 2 - PRODUCTS

2.1 THERE ARE NO PRODUCTS IN THIS SPECIFICATION

PART 3 - EXECUTION

3.1 PERFORMANCE REQUIREMENTS

A. General

1. Refer to Project Process Diagram (PPD) in 280500.10. Utilize the PPD to develop effective and timely project schedules and submissions to ensure project is substantially complete prior to occupancy.

3.2 CONTRACTOR'S FIELD TESTING

A. Perform the Contractor Field Test (CFT) of all devices utilizing Contracting representative provided forms.

B. Submit test results, including journal logs from Genetec, to COTR and Contracting representative.

3.3 PERFORMANCE VERIFICATION TEST (PVT)

A. Based on the approval of the Contractor's Field Test, the COTR will schedule the PVT with the Contractor and Contracting Representative.

B. Contracting representative will witness the Contractor conduct the PVT of all devices utilizing the same form as for the CFT.

C. Contracting representative reserves the right to stop and abort testing as soon as 10 technical deficiencies are found requiring correction.

1. If the acceptance test is aborted, the re-test will commence from the beginning with a retest of components previously tested and accepted.
2. The Contractor is responsible for all time, travel, and lodging expenses incurred for personnel required to be present for resumption of the PVT.

D. The PVT also includes a physical inspection of the installation quality and workmanship.

E. Submit test results, including journal logs from Genetec, to COTR and Contracting representative.

3.4 REFER TO 280500.10 FOR ALL OTHER PART III REQUIREMENTS

END OF SECTION

SECTION 28 11 16 - SECURITY RACKS, FRAMES, AND ENCLOSURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. 19-inch equipment racks.
2. 19-inch freestanding and wall-mounted equipment cabinets.
3. Power strips.
4. Grounding.
5. Labeling.

B. Related Requirements:

1. Section 271110 "Communications Equipment Room Fittings" for backboards and accessories.
2. Section 270526 "Grounding and Bonding for Telecommunications Equipment" for TMGBs and TGBs.
3. Section 270536 "Cable Trays for Communications Systems" for cable trays and cable tray accessories.
4. Section 271313 "Communications Copper Backbone Cabling" for copper data cabling associated with system panels and devices.
5. Section 271323 "Communications Optical Fiber Backbone Cabling" for optical-fiber data cabling associated with system panels and devices.
6. Section 271333 "Communications Coaxial Backbone Cabling" for coaxial data cabling associated with system panels and devices.
7. Section 271513 "Communications Copper Horizontal Cabling" for copper data cabling associated with system panels and devices.
8. Section 271523 "Communications Optical Fiber Horizontal Cabling" for optical-fiber data cabling associated with system panels and devices.
9. Section 271533 "Communications Coaxial Horizontal Cabling" for coaxial data cabling associated with system panels and devices.
10. Section 271611 "Communications Hybrid Cabling" for combined copper and optical fiber data cables associated with system panels and devices.

1.3 DEFINITIONS

A. Access Provider: An operator that provides a circuit path or facility between the service provider and user. An access provider can also be a service provider.

B. BICSI: Building Industry Consulting Service International.

C. LAN: Local area network.

D. RCDD: Registered communications distribution designer.

E. Service Provider: The operator of a telecommunications transmission service delivered through access provider facilities.

F. TGB: Telecommunications grounding bus bar.

G. TMGB: Telecommunications main grounding bus bar.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for equipment racks and cabinets.

2. Include rated capacities, operating characteristics, electrical characteristics, certifications, standards compliance, and furnished specialties and accessories.

B. Shop Drawings: For communications racks, frames, and enclosures. Include plans, elevations, sections, details, and attachments to other work.

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

2. Equipment Racks and Cabinets: Include workspace requirements and access for cable connections.

3. Grounding: Indicate location of TGB and its mounting detail showing standoff insulators and wall-mounting brackets.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer, qualified layout technician, installation supervisor, and field inspector.

B. Seismic Qualification Data: Certificates, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions. Base certification on the maximum number of components capable of being mounted in each rack type. Identify components on which certification is based.

3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Cabling installer must have personnel certified by BICSI on staff.

1. Layout Responsibility: Preparation of Shop Drawings shall be under direct supervision of [RCDD] [Technician].

2. Installation Supervision: Installation shall be under direct supervision of [Technician] [Installer 2, Copper or Fiber], who shall be present at all times when Work of this Section is performed at Project site.

3. Field Inspector: Currently registered by BICSI as [RCDD] [Technician] to perform on-site inspection.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Equipment shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. The term "withstand" means "the unit will remain in place without separation of any parts when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

B. UL listed.

C. RoHS compliant.

D. Compliant with requirements of the Payment Card Industry Data Security Standard.

2.2 BACKBOARDS

A. Backboards: Plywood, fire-retardant treated, 3/4 by 48 by 96 inches (19 by 1220 by 2440 mm). Comply with requirements for plywood backing panels specified in Section 061000 "Rough Carpentry."

2.3 19-INCH EQUIPMENT RACKS

1. By Division 27

2.4 UNINTERUPTIBLE POWER SOURCE

A. Each Rack will be fitted with a Uninterruptible Power source

B. Key Specifications

1. Model: SMART2200RMXLN

2. Load Capacity: 2.2 kVA (1920 W)

3. Power Factor: 0.87

4. Nominal AC Input: 120V, 60 Hz

5. Nominal AC Output: 120V, 60 Hz

6. AC Outlets: 4 x 5-15R, 4 x 5-15/20R

7. Switched Outlet Banks: 2 switchable single-outlet load banks (1 x 5-15/20R, 1 x 5-15R)

8. Output Waveform (AC Mode): Pure Sine Wave

9. Output Waveform (Battery Mode): Pure Sine Wave

10. Input Cord: 10 ft. (3 m) Cord with 5-20P Plug

11. Half-Load Runtime: 12 min. (960 W Load)

12. Communications: USB Port (HID-Compliant); Serial Port (DB9); Pre-Installed Network Card; EPO

13. User-Replaceable Battery: Yes (RBC94-2U)

14. Expandable Battery Runtime: Yes (Requires optional external battery pack)

15. External Battery Pack Compatibility: BP48V24-2U (limit 1); BP48V60RT-3U (multi-pack compatible); BP48V27-2US (multi-pack compatible)

16. Primary Form Factor: 2U Rack (Supports 4-post rack installation with included kit. Add 2POSTRMKITWM for 2-post rack or wall-mount installation. Add 2-9USTAND for tower installation.)

17. Dimensions: 3.5 x 17.5 x 19.5 in. (8.9 x 44.5 x 49.6 cm)

18. Weight: 57.6 lb. (26.2 kg)

19. Standards: UL 1778 (USA); CSA (Canada); NOM (Mexico); FCC (EMI); ENERGY STAR; RoHS

20. Product Warranty (Worldwide): 3-Year Limited Warranty (Registration required for third year.)

21. Connected Equipment Insurance (U.S., Canada and Puerto Rico): $250,000

22. What's Included: UPS, Pre-Installed Network Card, 4-Post Rack Installation Kit, USB/Serial/EPO Cabling, PowerAlert Software, Manual

2.5 GROUNDING

A. Comply with requirements in Section 270526 "Grounding and Bonding for Communications Systems" for grounding conductors and connectors.

B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Chatsworth Products, Inc.

2. Harger Lightning & Grounding; business of Harger, Inc.

3. Panduit Corp.

C. Rack and Cabinet TGBs: Rectangular bars of hard-drawn solid copper, accepting conductors ranging from No. 14 to No. 2/0 AWG, NRTL listed as complying with UL 467, and complying with TIA-606-B. Predrilling shall be with holes for use with lugs specified in this Section.

1. Cabinet-Mounted TGB: Terminal block, with stainless-steel or copper-plated hardware for attachment to cabinet.

2. Rack-Mounted Horizontal TGB: Designed for mounting in 19- or 23-inch (482.6- or 584.2-mm) equipment racks. Include a copper splice bar for transitioning to an adjoining rack, and stainless-steel or copper-plated hardware for attachment to the rack.

3. Rack-Mounted Vertical TGB: 72 or 36 inches (1828.8 or 914.4 mm) long, with stainless-steel or copper-plated hardware for attachment to rack.

2.6 ENCLOSURES

A. Field Distribution Enclosure – Vehicle Control Points
1. Rated: NEMA 4X
2. Construction: Stainless Steel
3. Hinge: Continuous
4. Latch: D Style with Construction Core
5. Dimensions: 22in (H) x 24in (W) x 8in (D)
6. Tamper: Tamper Switch, Toggle Style

2.7 LABELING

A. Comply with TIA-606-B and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1.

B. Comply with BICSI TDMM for layout of communications equipment spaces.

C. Comply with BICSI ITSIMM for installation of communications equipment spaces.

D. Bundle, lace, and train conductors and cables to terminal points without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.

E. Coordinate layout and installation of communications equipment in racks and room. Coordinate service entrance configuration with service provider.

1. Meet jointly with system providers, equipment suppliers, and Owner to exchange information and agree on details of equipment configurations and installation interfaces.

2. Record agreements reached in meetings and distribute them to other participants.

3. Adjust configurations and locations of distribution frames, cross-connects, and patch panels in equipment spaces to accommodate and optimize configuration and space requirements of telecommunications equipment.

4. Adjust configurations and locations of equipment with distribution frames, cross-connects, and patch panels of cabling systems of other communications, electronic safety and security, and related systems that share space in equipment room.

F. Coordinate location of power raceways and receptacles with locations of communications equipment requiring electrical power to operate.

3.2 GROUNDING

A. Comply with NECA/BICSI 607.

B. Install grounding according to BICSI ITSIMM, "Bonding, Grounding (Earthing) and Electrical Protection" Ch.

C. Locate TGB to minimize length of bonding conductors. Fasten to wall, allowing at least 2 inches (50 mm) of clearance behind TGB. Connect TGB with a minimum No. 4 AWG grounding electrode conductor from TGB to suitable electrical building ground. Connect rack TGB to near TGB or the TMGB.

Retain subparagraph below if screened twisted-pair cables and coaxial cables are in communications equipment spaces.

1. Bond the shield of shielded cable to patch panel, and bond patch panel to TGB or TMGB.

3.3 IDENTIFICATION

A. Coordinate system components, wiring, and cabling complying with TIA-606-B. Comply with requirements in Section 270553 "Identification for Electrical Systems."

B. Comply with requirements in Section 099123 "Interior Painting" for painting backboards. For fire-resistant plywood, do not paint over manufacturer's label.

C. Paint and label colors for equipment identification shall comply with TIA-606-B for Class 2 level of administration, including optional identification requirements of this standard.

D. Labels shall be machine printed. Type shall be 1/4 inch in height.

END OF SECTION

SECTION 28 13 00 – PHYSICAL ACCESS CONTROL SYSTEM

PART 1 - GENERAL

1.1 QUALITY ASSURANCE

A. Installer Qualifications: Must have on staff a registered communication distribution designer certified by Building Industry Consulting Service International.

1.2 RELATED SECTIONS

A. Section 280500 Common Work Results for Electronic Security

B. Section 280513 Conductors and Cables for Electronic Safety and Security" for cabling between master control units and field-mounted devices and control units.

C. Section 281300 Access Control that are used to control access to and throughout the facility and provide audit and reporting for all subsystems listed.

D. Section 281600 Intrusion Detection that provide sensor level intrusion for and throughout the facility and vehicle parking areas and utility areas.

E. Section 282300 Video surveillance systems shall be integrated with monitoring and control system specified in Section 280500 “Electronic Security”, Section 281600 "Intrusion Detection,”

1.3 DESCRIPTION

A. Security Access System: PC-based central station and field-installed controllers, connected by a high-speed electronic data transmission network.

B. Network Connecting the Central Station and Workstations: LAN.

C. Network(s) Connecting PCs and Controllers:

1. Local area, Fast Ethernet Gigabit-Ethernet, star topology network based on TCP/IP.

1.4 SUMMARY

A. This Section includes access control devices to be connected to the Security Management System (SMS).

1. Access Control:

a. Regulating access through doors, gates, traffic-control bollards and others access controls as specified in drawing documents.
b. Anti-passback where required.
c. Surge and tamper protection.

d. Secondary alarm annunciator.
e. Card readers.
f. Push-button switches.
g. Reporting.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Genetec or approve equal

2.2 ACCESS CONTROL SYSTEM

A. Electronic Access Control System General Requirements

1. The ACS shall be an enterprise class IP access control software solution. It shall be fully embedded within a Unified Security Platform (USP). The USP shall allow the seamless unification of the ACS with an IP video management system (VMS).

2. The ACS shall be highly scalable to support configurations consisting of thousands of doors with facilities spanning multiple geographic areas.

3. The ACS shall support an unrestricted number of logs and historical transactions (events and alarms) with the maximum allowed being limited by the amount of hard disk space available.

4. The ACS shall support a variety of access control functionalities, including but not limited to:

a. Controller (Unit) management, door management, elevator management, and area management.

b. Cardholder and cardholder group management, credential management, and access rule management.

c. Badge printing and template creation.

d. Visitor Management. (Specifier, additional license required)

e. People counting, area presence tracking, and mustering.

f. Offering a framework for third party hardware integration such as card and signature scanner.

B. Manufacturer:

1. Genetec Security Center: *(Specifier, select one of the following)*

a. Synergis Enterprise

b. Synergis Professional

c. Synergis Standard

C. Certification

1. The ACS shall be certified

a. UL-294

b. ULC-S319

c. EN-60839-11-1

d. CSPN

2.3 FAILOVER AND STANDBY REQUIREMENTS

A. The USP shall support native and off-the-shelf failover options.

B. Failover Directory *(Specifier, additional license required per server that will failover, Enterprise only)*

1. The Standby Directory shall act as a replacement SSM on hot standby, ready to take over as the acting Directory in case the primary Directory fails. The failover shall occur in less than 1 minute. No action from the user shall be required.

2. The USP shall support up to five (5) Directories on standby, lined up to take over as the acting Directory in a cascading fashion.

3. The Standby Directory shall keep its configuration database synchronized with the primary Directory.

4. The Standby Directory shall support disaster recovery scenarios where a server can be located in another geographic area (or building) and only take over if all other Directories become offline.

5. The Standby Directory shall support synchronization of the configuration databases using a backup and restore mechanism. The synchronization period shall be configurable from 15 minutes to 1 week.

6. The Standby Directory shall support real-time synchronization of the configuration databases using SQL Mirroring or SQL Always On.

C. Off-the-shelf standby/failover options (excluding the VMS Archiver) shall include: *(Specifier, additional license required per server that will failover, Enterprise only)*

1. Native role failover across multiple servers

2. Windows Clustering

3. NEC ExpressCluster X LAN

2.4 ACS ACCESS MANAGEMENT

A. The ACS shall be based on an open architecture able to support multiple access control hardware manufacturers. The ACS shall be able to integrate with multiple non-proprietary interface modules and controllers, access readers, and other third party applications.

B. The ACS shall be an IP enabled solution. All communication between the ACS and hardware controllers shall be based on standard TCP/IP protocol.

C. Access Manager Role

1. The Access Manager Role shall be the server that synchronizes all access control hardware units under its control, such as door controllers and I/O modules. It shall also be able to validate and log all access activities and events when the door controllers and I/O modules are online.

2. The Access Manager Role shall maintain the communication link with the hardware controllers under its control. It shall also continuously monitor whether the controllers are online or offline.

3. Synchronization of hardware units shall be automated and transparent to users and shall occur in the background. It shall also be possible to manually synchronize units or to synchronize units on a schedule.

4. The Access Manager Role shall support doors and controllers located within one or more facilities. The Access Server shall support a minimum of 200 readers and up to 2000 readers per computer.

D. The Access Server shall store all access events associated with the doors, areas, hardware zones (hardware input points), elevators, and controllers under its direct control.

2.5 ACS GLOBAL CARDHOLDER MANAGEMENT

A. The ACS shall support global cardholder management and synchronization between a central independent site and remote independent sites, all of which can have their own Directory and databases.

B. It shall be possible to synchronize the following entities and their configuration data:

1. Cardholders (incl. custom fields)

2. Cardholder groups

3. Credentials

4. Badge templates

C. Cardholders and other synchronized entities can be added centrally and synchronized to remote sites for central cardholder management.

D. Cardholders and other synchronized entities can be added at remote sites and synchronized to the central site and other remote sites.

E. The ACS shall support the assignment of a single card per cardholder across all of an organization's sites.

F. Manual and scheduled synchronization shall be supported.

G. The ACS shall support Manufacturer OSDP command.

2.6 ACS HARDWARE COMPATIBILITY LIST

A. The ACS shall have an open architecture that supports the integration of third party IP-based door controllers and I/O modules. The ACS shall simultaneously support mixed configurations of access control hardware from multiple vendors.

B. The ACS shall support SAM onboard to hold DESfire encryption keys.

C. The ACS shall support 802.1x authentication.

D. The ACS shall support embedded certificate validation engine.

E. The ACS shall support the use of TLS 1.2 and certificates.

F. The ACS shall support OSDP Secure Channel.

G. The ACS shall support OSDP transparent reader mode to read DESfire credentials.

H. The ACS shall support multiple types of hardware devices: single-reader controllers, 2-reader controllers, 1- to 64-reader controllers, integrated readers and door controllers, and Power-over-Ethernet (PoE) enabled door controllers.

I. The ACS shall support most industry standard card readers that output card data using OSDP and Wiegand protocol, and Clock-and-Data.

J. The ACS shall support the following IP-enabled controllers. For a description of the capabilities of the controller, refer to the specific controller's A&E specifications and design:

1. Synergis Master Controller

2. Synergis Cloud Link

3. Synergis IX

4. SharpV

5. HID VertX

6. HID VertX EVO
7. HID Edge
8. HID Edge EVO
9. PW6000 controllers
10. Mercury EP controllers
11. Mercury LP controllers
12. Mercury SIO module
13. Mercury M5 Bridge
14. Mercury MS Bridge
15. Assa Abloy Aperio RS485 8 to 1 hub
16. Assa Aperio AH40 (IP) hub
17. Assa Abloy IP Locks (no DSR required)
    a. Corbin Russwin
    b. Sargent Passport
    c. Sargent Profile
    d. IN220
18. Salto Sallis RS485 and PoE routers
19. Salto SVN
20. Schlage AD-300 and AD-400 electronic locks
21. Schlage Control wireless lock
22. Schlage NDE, LE, FE, and BE Networked wireless Mortise lock
23. Axis A1001
24. Axis A1601
25. STid RS485 readers
26. DDS AS34/TPL4
27. SimonsVoss Smart Intego

K. The following USB enrollment readers shall be supported:

1. RF Ideas pcProx HID USB reader for enrolling proximity cards

2. RF Ideas AIR ID Enroll iCLASS ID# USB reader for enrolling HID iCLASS cards

3. RF Ideas AIR ID Enroll 14443/15693 CSN USB reader for enrolling a MIFARE card using the CSN (card serial number)

4. RF Idea AIR ID Enroll pcProx Plus w/iCLASS reader for enrolling proximity and iCLASS cards

5. STid STR-W35-E/PH5-5AA

6. HID Omnikey 5x2x USB readers

2.7 SEAMLESS UNIFICATION WITH VMS

A. Through the USP, the ACS shall support integration with an IP Video Surveillance System or MVS. Integration with an IP video surveillance system shall permit the user to view live and recorded video.

B. Users shall be able to associate one or more video cameras to the following entity types: doors, elevator and hardware zones (input points), and more.

C. The Monitoring UI shall present a true Unified Security Interface for access control and video surveillance. Advanced live video viewing and playback of archived video shall be available through the Monitoring UI.

D. It shall be possible to view video associated with access control events when viewing a report.

2.8 ACS CONTROLLER (UNIT) MANAGEMENT

A. The ACS shall support the discovery, configuration, and management of IP enabled controllers and I/O modules (hardware units). A user shall be permitted to add, delete, or modify a controller if they have the appropriate privileges.

B. The ACS shall support unit configuration through a preconfigured door template.

C. The ACS shall support automatic unit discovery. The user shall establish the settings for discovery ports and for the types of unit discovery and the ACS shall automatically detect all connected devices.

D. The ACS shall support a unit swap utility for swapping out an existing controller with a new controller. The unit swap utility shall avoid the reprogramming of the system whenever a unit is replaced. All logs and events from the old unit shall be maintained.

E. The ACS shall support pre-configuration of the system prior to the physical hardware installation.

F. The ACS shall support Firmware upgrade in bulk from the application.

G. The ACS shall support MIFARE DESfire configuration central management.

2.9 ACS CARDHOLDER AND CARDHOLDER GROUP MANAGEMENT

A. The ACS shall support the configuration and management of cardholders and cardholder groups. A user shall be able to add, delete, or modify a cardholder or cardholder group if they have the appropriate privileges.

B. Custom fields shall be supported for both cardholders and cardholder groups.

C. The ACS shall permit the following activation/expiration options for a cardholder's profile: delayed activation of a cardholder's profile, expiration based on the date of first use of credentials, or expiration on a user-defined date.

D. It shall be possible to set a start date and expiration date for the association of a cardholder and an access rule for temporary access.

E. It shall be possible to associate a picture to a cardholder's profile. The picture shall be imported from a file, captured with a digital camera, or captured from a video surveillance camera. When a cardholder event occurs, the picture of the cardholder shall be displayed in the Monitoring UI. The ACS shall support multiple standard picture formats.

F. Cardholder groups shall enable the grouping of cardholders to facilitate mass changes to system settings. It shall be possible to assign cardholder groups to access rules, thus avoiding the assignment of one cardholder at a time.

G. It shall be possible to search by picture association, custom fields, names, and credential codes.

H. It shall be possible to select multiple cardholders for immediate deactivation or reactivation.

I. The ACS shall support the synchronization of cardholders and cardholders group through Active Directory including the credentials and pictures of the cardholders. *(Specifier, Active Directory integration requires a license and available in Professional and up).* It shall be possible to import cardholders from Azure AD.

J. It shall support the ability to track unused credentials for x days.

2.10 ACS CREDENTIAL MANAGEMENT

A. The ACS shall support the configuration and management of credentials, for example access cards and keypad PIN numbers. A user shall be able to add, delete, or modify a credential if the user has the appropriate privileges.

B. The ACS shall support reader transparent mode.

C. Users shall be able to add Custom Fields (user-defined fields) to credentials. Creating a new credential shall be accomplished either manually or automatically.

D. Automatic creation shall allow the user to create a credential entity by presenting a credential to a selected reader. The ACS shall read the card data and associate it to the credential entity. It shall be possible to automatically enroll any card format.

E. The ACS shall support high assurance credentials using validation of a certificate, such as PIV, PIV-I, and CIV.

F. The ACS shall support multiple credentials per cardholder without necessitating duplicate cardholder information. The ACS shall automatically detect and prevent attempts to register an already-registered credential.

G. It shall be possible to natively encode DESfire credentials from the user interface using customer's own keys and configuration.

H. Batch enrollment of credentials shall be supported.

I. The ACS shall provide a workflow for badge issuance and card requests.

J. It shall be possible to support natively PIV credential in the system.

K. The ACS shall support the use of license plates as a credential.

L. The ACS shall support duress pin.

M. The ACS shall natively support the creation and management of mobile IDs in the same way as other credentials.

2.11 ACS CUSTOM CARD FORMATS

A. A custom card format feature shall allow the administrator to add additional custom card formats using an intuitive tool within the Configuration UI. The custom card format tool shall be flexible in the following ways:

1. Once enrolled, new custom card formats shall appear in the card format lists for manual card enrollment.

2. An unrestricted number of additional custom card formats can be added.

3. Shall support credential with up to 256 bits.

4. The administrator shall be able to set the following options when defining a new format:

   a. The order in which card fields appear in the user interface or CSA.

   b. Whether a field is hidden from or visible to an operator.

   c. Whether a field is read only or modifiable by an operator.

   d. Complex parity checking schemes.

   e. The order and location of a field's data. Location can be defined on a bit-by-bit basis.

   f. Application ID and keys for DESfire EV1 credentials.

2.12 ACS BADGE DESIGNER

A. The badge designer shall allow the creation of badge templates that define the content and presentation format of a cardholder badge to be printed.

B. Badge production shall consist of selecting the credential, the badge template, and clicking print.

C. Batch printing of cards shall be available.

D. The contents of a badge template can include: cardholder's first and last name, picture, custom fields, bitmap graphics, lines, ovals, rectangles, dynamic text labels linked to custom fields and static text labels, and barcodes (Interleaved 2 of 5, Extended Code 39).

E. Copy and paste of badge template objects shall be available.

F. It shall be possible to set the border thickness and color, the fill color of badge objects (content), and the color of text labels.

G. Settings, such as object transparency, text orientation, and auto-sizing of text shall be available or transparent to the user.

H. Supported badge formats shall be (portrait and landscape): CR70 (2.875" x 2.125"), CR80 (3.37" x 2.125"), CR90 (3.63" x 2.37"), CR100 (3.88" x 2.63"), and custom card sizes.

I. Dual-sided badges shall be supported.

J. A badge template import and export function shall be available to allow the sharing of badge templates between distinct or independent ACS.

K. Chromakey shall be supported.

2.13 ACS DOOR MANAGEMENT

A. The ACS shall support the configuration and management of doors. A user shall be able to add, delete, or modify a door if they have the appropriate privileges.

B. The ACS shall permit multiple access rules to be associated to a door.

C. It shall be possible to unlock all doors from an area at once.

D. The ACS shall support the following forms of authentication: Card Only, Card or Keypad (PIN), or Card and Keypad (PIN). It shall be possible to define a schedule for when Card Only or Card and Keypad authentication modes shall be required.

E. It shall be possible to set an extended grant time on a per-door basis (in addition to the standard grant time). Cardholder properties shall include the option of using the extended grant time. When flagged cardholders are granted access, the door shall be unlocked for the duration of the extended grant time instead of the standard grant time.

F. The ACS shall allow the configuration of the relocking mode on doors such as on door open, after a definite time, or on door close.

G. The ACS shall support the ability to enforce the use of two valid reads from different cardholders to grant access to an area.

H. The ACS shall support the ability to enable access rules for other cardholders once a supervisor has accessed an area.

I. The ACS shall support the ability to enable unlocking schedule on a door once an employee has entered the facility.

J. Readerless doors.

1. The ACS shall support doors configured solely with a lock, a REX, and a door contact but without readers.

2. The implementation of a readerless door shall be possible with the use of standard access hardware IO modules. External hardware, such as timers, shall not be required.

3. Unlocking schedules shall be programmable for readerless doors.

4. Standard door activity reports shall also be possible with readerless doors.

K. Unlocking schedules and exceptions to unlocking schedules shall be associated with a door. An unlocking schedule shall determine when a door should be automatically unlocked. The ACS shall also support the use of a specific offline unlocking schedule. Exceptions to unlocking schedules shall be used to define time periods during which unlocking schedules shall not be applied, such as during statutory holidays.

L. The ACS shall support one or more cameras per door. Video shall then be associated to door access events, such as access grant or access denied.

2.14 ACS ELEVATOR MANAGEMENT

A. The ACS shall support the configuration and management of elevators. A user shall be able to add, delete, or modify an elevator if they have the appropriate privileges.

B. The ACS shall be able to control access to specific floors using a reader within the elevator cab. Control shall be available through the use of a controller with an interface to a reader and to multiple output modules with relays.

C. Elevator floor selections shall be tracked using a controller with an interface to multiple input modules. Floor tracking shall be available within an elevator activity report.

D. The elevator control module shall continue to function in offline mode should communication between the ACS and the controller fail.

E. The ACS shall support one or more cameras per elevator cab. Video shall then be associated to elevator access events, such as access granted or access denied.

2.15 ACS VISITOR MANAGEMENT *(SPECIFIER, ADDITIONAL LICENSE REQUIRED)*

A. The ACS shall support the configuration and management of visitors. A user shall be able to enroll or remove a visitor if they have the appropriate privileges. The ACS shall support the check-in and check-out of visitors from the Monitoring UI.

B. A visitor check-in wizard shall facilitate the enrollment process, allowing a user to specify the visitor's specific information.

C. It shall be possible to set a host leading a group of visitors and a trailing host walking behind visitors, triggering alert if a visitor is not following the delegation.

D. The ACS shall permit the following credential options during visitor check-in:

1. Use an existing credential.

2. Automatically create a new credential.

3. Manually create a new credential.

E. The ACS shall support the creation of a pool of visitor credentials in advance. Existing visitor credentials shall be assigned to visitors during the check-in process.

F. The ACS shall permit cardholder groups to be designated as "available for visitors". Users shall be able to define the access privileges for the cardholder groups (visitor cardholder groups) in advance. During visitor check-in, the user shall select the appropriate visitor cardholder group to associate with a visitor. All of the visitor cardholder group access privileges shall be automatically transferred to the visitor. This feature shall permit the creation of multiple types of visitor groups and associated privileges, such as for contractors, VIPs, and day visitors. Visitors added to a visitor cardholder group in the Monitoring UI shall be automatically updated in the Configuration UI cardholder group screen.

G. A visitor's profile shall support the real-time modification of visitor information after a visitor has checked-in.

H. The ACS shall also provide comprehensive visitor tracking and visitor reporting. Through the real-time tracking feature, the ACS shall generate a real-time and historical visitor activity listing in the Monitoring UI. The ACS shall also generate visitor-specific reports that provide comprehensive listings of visitors as well as full details on their movement.

I. It shall be possible to exempt a visitor from any antipassback rules in effect.

J. The operator shall be able to print visitor badges during the check-in process. The printing of both paper badges (visitor without an assigned credential) and actual credentials shall be supported.

K. Visitor management and reporting shall be available through the Web Client as well.

L. It shall be possible to locate a visitor`s information or profile by swiping the visitor's credential (card) at a USB reader.

M. It shall be possible to tag the person visited to the visitor's profile.

N. It shall be possible to require that the visitor must have an escort to enter an area and that the escort must badge-in to confirm the access of the visitor.

O. The ACS system shall support third party visitor management solutions. *(Specifier, additional license required)*

2.16 ACS PEOPLE COUNTING & AREA PRESENCE TRACKING (MUSTERING) *(SPECIFIER, ADDITIONAL LICENSE REQUIRED)*

A. The ACS shall support people counting (or area presence tracking). The ACS shall be able to monitor and report the number of cardholders in an area in real-time and for all areas. Monitoring shall be based on the entire access control infrastructure, for both local areas and those in remote geographic locations. People counting can also be used to perform mustering.

B. It shall be possible to control the maximum occupancy of an area by setting a threshold and user notification when reaching the limit.

C. The ACS shall report area presence counts in the UI. Area presence tracks shall dynamically track the total number of cardholders in an area. Displayed data shall be updated dynamically.

D. The ACS shall support mustering through the use of mobile readers (requires additional software and hardware from third-party).

E. The ACS shall provide a native dedicated mustering task using a USB, mobile, or wall reader.

F. The ACS shall be able to generate an area presence report listing the cardholders located in one or more areas, accessible through the Monitoring UI. It shall be possible to filter the report by area and time period. The report shall also include activity from sub-areas (nested areas).

G. Through people counting, the ACS shall be able to generate First Person In and Last Person Out events. The First Person In event shall detect when the first cardholder enters an empty area. The Last Person Out event shall detect when the last cardholder leaves an area. It shall be possible to trigger actions from both events such as sending a message or triggering an alarm.

H. The ACS shall be able to determine the entry of a cardholder based on a dedicated sensor.

I. The ACS shall provide a visual HTML dashboard to aid with the evacuation that can run on mobile devices.

J. The ACS shall provide the ability to globally view all evacuations simultaneously or per area.

K. On an evacuation, the ACS shall set all cardholders as unknown until they reach a mustering point.

L. It shall be possible to mark a cardholder as safe or unsafe from the web evacuation assistant.

M. It shall be possible to filter by cardholder groups or custom fields in the mustering dashboard.

N. The ACS shall support wall-mounted readers and mobile-handled devices for mustering.

O. The ACS shall provide distinct visual indication as an area is being evacuated.

P. The ACS shall have the ability to configure a mustering point per area.

Q. The ACS shall have the ability to reset APB at the end of an evacuation.

2.17 ACS CUSTOM FIELDS (USER-DEFINED FIELDS)

A. The ACS shall permit the creation of custom fields. Up to 1,000 custom fields shall be supported.

B. Custom fields shall be supported for the following entities: cardholders, cardholder groups, credentials, and visitors.

C. Supported custom fields shall include text, integers, decimal numbers, dates, Boolean, and images (graphics).

D. Users shall be able to define a default value for a custom field.

E. The creation of new custom field types shall be possible. New custom field types shall be based on the standard custom fields supported. They shall support user-defined values from which an operator must make a selection.

F. Administrators have the ability to define which users can view and modify specific custom fields. This shall limit the access to custom field data to users with pre-defined privileges. The ACS shall support querying and report generation using custom fields.

G. Custom fields can be grouped and ordered within these groups as defined by the user.

H. Values for custom fields can be imported using the Import Tool.

2.18 ACS IMPORT TOOL *(SPECIFIER, ADDITIONAL LICENSE REQUIRED)*

A. The ACS shall support an integrated Import Tool to facilitate the import of existing cardholder and credential data. The import of data shall be through the use the CSV file format. The tool shall be available from the Configuration UI.

B. It shall be possible to connect to an external Microsoft SQL or Oracle database to import cardholders.

C. The Import Tool shall also support the ability to manually import data that has been exported from a third party database if it is in CSV format.

D. The import tool shall permit the import of the following data:

1. Cardholder name, descriptions, picture, email, and status.

2. Cardholder group information.

3. Credential name, status, format, and card number (including credentials with custom formats).

4. Partition information.

5. Custom fields.

6. Activation date and expiration date.

7. Update cardholder group association.

E. Full flexibility in selecting the fields to be imported during an import session shall be available.

F. The option to use a custom and unique cardholder key shall be specified during the import process to ensure that cardholders with duplicate names will not have their data overwritten. Cardholder key generation shall be automated. The end user shall have the option to select which fields will be used to create this unique key, for example credential number, custom fields, or cardholder name.

G. The ACS shall also support re-importing a CSV file containing new information to update existing information in the ACS database. Re-importing shall enable bulk amendments to existing access control data.

2.19 GENERAL CLIENT SOFTWARE REQUIREMENTS

A. The Client Software Applications (CSA) shall provide the user interface for USP configuration and monitoring over any network and be accessible locally or from a remote connection.

B. The CSA shall consist of the Configuration UI for system configuration and the Monitoring UI for monitoring. The CSA shall be Windows-based and provide an easy-to-use graphical user interface (UI).

C. The CSA for monitoring shall support running in 64-bit mode.

D. The Server Administrator shall be used to configure the server database(s). It shall be web-based and accessible locally on the SSM or across the network.

E. The CSA shall seamlessly merge access control, license plate recognition (ALPR), and video functionalities within the same user application.

F. The USP shall use the latest user interface (UI) development and programming technologies such as Microsoft WPF (Windows Presentation Foundation), the XAML markup language, and the .NET software framework.

G. All applications shall provide an authentication mechanism, which verifies the validity of the user. As such, the administrator (who has all rights and privileges) can define specific access rights and privileges for each user in the system.

H. Logging on to a CSA shall be done either through locally stored USP user accounts and passwords or using the operator's Windows credentials when Active Directory integration is enabled. *(Specifier, Professional and up, additional license required for Active Directory)*

I. When integrated with Microsoft's Active Directory, the CSA and USP shall authenticate users using their Windows credentials. As a result, the USP will benefit from Active Directory password authentication and strong security features. *(Specifier, Professional and up, additional license required)*

J. When integrated with an external identity provider such as Windows Active Directory, ADFS (Active Directory Federation Services) or an Open ID Connect/SAML2 identity provider (ex.: Azure AD), the CSA and USP shall authenticate using a Single-Sign On experience to the users. As a result, the USP will benefit from reusing the same credential throughout enterprise applications. *(Specifier, Professional and up, additional license required).*

K. The CSA shall support multiple languages, including but not limited to the following: English, French, Arabic, Czech, Dutch, German, Hebrew, Hungarian, Italian, Japanese, Korean, Norwegian, Persian (Farsi), Polish, Portuguese (Brazilian), Simplified and Traditional Chinese, Russian, Spanish, Swedish, Thai, Turkish, and Vietnamese.

L. To enhance usability and operator efficiency, the Configuration UI and Monitoring UI shall support many of the latest UI such as:

1. A customizable Home Page that includes favorite and recently used tasks.

2. Task-oriented approach for administrator/operator activities where each type of activity (surveillance, visitor management, individual reports, and more) is an operator task.

3. Consolidated and consistent workflows for video, ALPR, and access control.

4. Single click functionality for reporting and tracking. The Monitoring UI shall support both single-click reporting for access control, ALPR, and video, as well as single-click tracking of areas, cameras, doors, zones, cardholders, elevators, ALPR entities, and more. Single-click reporting or tracking shall create a new task with the selected entities to report on or track.

M. Configuration UI and Monitoring UI Home Page and Tasks

1. The Configuration UI and Monitoring UI shall be task-oriented.

2. A task shall be user interface design patterns whose goal is to simplify the user interface by grouping related features from different systems such as video and access, in the same display window. Features shall be grouped together in a task based on their shared ability to help the user perform a specific task.

3. Tasks shall be accessible via the Home Page of either the Configuration or the Surveillance CSA.

4. Newly created tasks shall be accessible via the Configuration UI or the Monitoring UI taskbar.

5. Similar tasks shall be grouped into the following categories:

a. Operation: Access control management, LRP management, and more.

b. Investigation: access control activity reports, visitor activity reports, alarm reports, and more.

c. Maintenance: Access control and, troubleshooters, audit trails, health-related reports, and more.

1. An operator shall be able to launch a specific task only if they have the appropriate privileges.

2. The Home Page content shall be customizable through the use of privileges to hide tasks that an operator should not have access to and through a list of favorite and recently used tasks. In addition, editing a USP XML file to add new tasks on the fly shall also be possible.

N. The Contractor shall provide up to XX number of simultaneous Clients. *(Specifier, client connections are concurrent, the first 5 client connections are included, specify a Site License after 40 client connections (Enterprise only))*

2.20 CONFIGURATION USER INTERFACE (UI)

A. General

1. The Configuration UI application shall allow the administrator or users with appropriate privileges to change the system configuration. The Configuration UI shall provide decentralized configuration and administration of the USP system from anywhere on the IP network.

2. The configuration of all embedded ACS, VMS, and ALPR systems shall be accessible via the Configuration UI.

3. The Configuration UI shall have a home page with single-click access to various tasks.

4. The Configuration UI shall include a variety of tools such as troubleshooting utilities, import tools, and a unit discover tool, amongst many more.

5. The Configuration UI shall include a static reporting interface to:

a. View historical events based on entity activity. The user shall be able to perform such actions as printing a report and troubleshooting a specific access event from the reporting view.

b. View audit trails that show a history of user/administrator changes to an entity.

6. Common entities such as users, schedules, alarms, and many more, can be reused by all embedded systems (ACS, VMS, and ALPR).

2.21 ACS CLIENT USER INTERFACE (UI)

A. The Monitoring UI shall fulfill the role of a Unified Security Interface that is able to monitor video, ALPR, and access control events and alarms, as well as view live and recorded video.

B. The Monitoring UI shall provide a graphical user interface to control and monitor the USP over any IP network. It shall allow administrators and operators with appropriate privileges to monitor their unified security platform, run reports, and manage alarms.

C. To enhance usability and operator efficiency, the Monitoring UI shall support the following UI concepts:

1. Dynamically adaptive interface that adjusts in real-time to what the operator is doing.

2. Dynamic controls loaded with entity-specific widgets (for example, door and camera widgets).

3. Use of transparent overlays that can display multiple types of data in a seamless fashion.

4. Display tile menus and quick commands.

5. Consolidated and consistent workflows.

6. Tile menus and quick commands easily accessible within every display tile of the user workspace.

7. Single click functionality for reporting and tracking. The Monitoring UI shall support both single-click reporting for access control, ALPR, and video, as well as single-click tracking of areas, cameras, doors, zones, cardholders, elevators, ALPR entities, and more. Single-click reporting or tracking shall create a new task with the selected entities to report on or to track.

D. Monitoring UI Home Page and Tasks

1. Similar tasks shall be grouped into the following categories:

a. Operation: Access control/LRP/video surveillance, visitor management, mustering, access control and video alarm monitoring, and more.

b. Investigation: Video bookmark/motion/archive reports, access control activity reports, visitor activity reports, alarm reports, ALPR activity reports, and more.

c. Maintenance: Access control and video configuration reports, troubleshooters, audit trails, and more.

E. Dynamically Adaptive UI, Controls section, and Widgets

1. The Monitoring UI shall dynamically adapt to what the operator is doing. This shall be accomplished through the concept of widgets that are grouped in the Monitoring UI Controls section.

2. Widgets shall be mini-applications or mini-groupings in the Monitoring UI Controls section that let the operator perform common tasks and provide them with fast access to information and actions.

3. With a single click on an entity (for example, door or camera) the specific widgets associated to that entity appear and other non-relevant widgets disappear dynamically (instantly). Widgets shall bring the operator information such as door status and camera stream information, as well as user actions, such as door unlock, PTZ controls, and more.

4. Specific widgets include those for a door, camera, alarm, zone, display tile, video stream (statistics), PTZ camera, and more.

F. Operator Workflows

1. A workflow shall be a sequence of operations an operator or administrator shall execute to complete an activity. The “flow” relates to a clearly defined timeline or sequence for executing the activity.

2. The Monitoring UI shall be equipped with consistent workflows for the ALPR, video, and access control systems that it unifies.

3. Generating or printing a report, setting up or acknowledging an alarm, or creating an incident report shall follow the same process (workflow) whether the operator is working with video, ALPR, or access control, or with both video and access control.

G. Each task within the Monitoring UI shall consist of one or more of the following items:

1. Event list.

2. Logical tree. Doors, cameras, zones, ALPR units, and elevators shall be grouped under Areas in a hierarchical fashion.

3. Entities list of all entities being tracked.

4. Display tiles with various patterns (1 x 1, 2 x 2, and more).

5. Display tile menu with various commands related to cameras, doors, PTZ, and tile controls.

6. Control section with widgets.

H. The Monitoring UI shall support multiple event lists and display tile patterns, including:

1. Event/alarm list layout only

2. Display tile layout only

3. Display tile and alarm/event list combination

4. ALPR map and alarm/event list combination

I. User workspace customization

1. The user shall have full control over the user workspace through a variety of user-selectable customization options. Administrators shall also be able to limit what users and operators can modify in their workspace through privileges.

2. Once customized, the user shall be able to save their workspace.

3. The user workspace shall be accessible by a specific user from any client application on the network.

4. Display tile patterns shall be customizable.

5. Event or alarm lists shall span anywhere from a portion of the screen up to the entire screen and shall be resizable by the user. The length of event or alarm lists shall be user-defined. Scroll bars shall enable the user to navigate through lengthy lists of events and alarms.

6. The Monitoring UI shall support multiple display tile patterns (e.g. 1 display tile (1x1 matrix), 16 tiles (8x8 matrix), and multiple additional variations).

7. The Monitoring UI shall support as many monitors as the PC video adapters and Windows Operating System are capable of accepting.

8. Additional customization options include show/hide window panes, show/hide menus/toolbars, show/hide overlaid information on video, resize different window panes, and choice of tile display pattern on a per task basis.

J. The Monitoring UI shall provide an interface to support the following tasks and activities common to access control, ALPR, and video:

1. Monitoring the events from a live security system (ACS and/or VMS and/or ALPR).

2. Generating reports, including custom reports.

3. Monitoring and acknowledging alarms.

4. Creating and editing incidents and generating incident reports.

5. Displaying dynamic graphical maps and floor plans, as well as executing actions from dynamic graphical maps and floor plans.

6. Management and execution of hot actions and macros.

K. The Monitoring UI shall be able to monitor the activity of the following entities in real-time: areas, ALPR entities, doors, elevators, cameras, cardholders, cardholder groups, zones (input points), and more. The Monitoring UI shall provide an interface to support the following access control tasks and capabilities:

1. Monitoring and management of access events and alarms.

2. Viewing of cardholder picture or badge IDs.

3. Verification of cardholder picture IDs against live video.

4. Visitor management.

5. People counting or mustering, including resetting the people count in an area.

6. Door control, including remotely unlocking doors, overriding a door’s unlocking schedules, and enabling door maintenance mode.

7. Forgiving antipassback.

8. Generation of ACS configuration and activity reports.

9. Viewing of HTML files including alarm instructions.

L. Entity Monitoring

1. The USP shall permit the user to select multiple entities to monitor from the Monitoring UI by adding the entities one by one to the tracking list.

2. The Monitoring UI shall provide the option to filter which events shall be displayed in the display tile layout, event list layout, or both.

3. It shall be possible to lock a Monitoring UI display tile so that it only tracks the activity of a specific entity (for example, a specific door or camera).

4. The user shall be able to drag and drop an event from an event list (or an alarm from an alarm list) onto a display tile to view a license plate read, cardholder picture ID, badge ID, or live/archived video, among other options.

5. Event, alarm, monitoring/tracking, and report lists shall contain cardholder pictures where applicable.

6. The user shall be permitted to start or pause the viewing of events within each display tile.

M. Display Tile Packing and Unpacking

1. The Monitoring UI shall support single-click unpacking and packing for, areas, doors, zones, and alarms.

2. The packing and unpacking of entities shall allow operators to quickly obtain additional information and camera views of a specific entity.

3. The unpacking of an entity shall display associated entities. For example, unpacking a door with multiple associated cameras shall display all cameras associated with that door. Unpacking shall reconfigure the display tiles to be able to display all associated entities. For example, unpacking a door (or a zone or alarm) that is currently in a 1 x 1 tile configuration and that has 3 cameras tied to it will create a 1 x 3 display tile arrangement for viewing all associated entities.

4. Packing will return the display to the original tile pattern.

N. The following additional tools or utilities shall be available from the Monitoring UI: create credentials, create cardholders, and access control troubleshooter.

2.22 SERVER ADMINISTRATOR USER INTERFACE REQUIREMENTS

A. The Server Administrator shall be used to configure the SSM and the Directory Role (main configuration) and its database(s), to apply the license, and more.

B. The Server Administrator shall be a web-based application. Through the Server Administrator, it shall be possible to access the SSM across the network or locally on the server.

C. Access to the Server Administrator shall be protected via login name, password, and encrypted communications.

D. The Server Administrator shall allow the administrator (user) to perform the following functions:

1. Manage the system license.

2. Configure the database(s) and database server for the Directory Role.

3. Activate/Deactivate the Directory Role.

4. Manually back up the Directory Role database(s) and/or restore the server database(s), as well as configure scheduled backups of the databases.

5. Define the client-to-server communications security settings.

6. Configure the network communications hardware, including connection addresses and ports.

2.23 UNIFIED WEB CLIENT (UWC) GENERAL REQUIREMENTS

A. The USP shall support a unified web client (UWC) for access control, video, and automatic license plate recognition (ALPR).

B. The UWC shall be a truly thin client with no download required other than an internet web browser or standard web browser plugins.

C. The UWC shall be platform independent and run within Microsoft Edge, MS Internet Explorer, Firefox, Safari, and Google Chrome.

D. The UWC shall be designed as an HTML5 application.

E. The UWC shall support display on tablet format.

F. The UWC will support native H.264 video in the web client.

G. Web pages for the web client shall be managed and pushed by the Web Client Server. Microsoft IIS or any other web hosting service shall not be required given that all the web pages shall be hosted by the Mobile Server.

H. The Web Client Server shall provide the ability to define a unique URL to access the web client, to ensure the security of the application.

I. The UWC shall provide the ability to load a camera layout.

J. The UWC shall provide the ability to configure, save, and reload private camera layouts.

K. The UWC shall provide the ability to control PTZ cameras.

L. Functionalities:

1. Log in support shall be available using:

a. Username and password

b. Active Directory *(Specifier, Professional and up, additional license required for Active Directory)*

c. Azure Active Directory, ADFS, OpenID Connect or SAML2 identity provider *(Specifier, Professional and up, additional license required for OIDC & SAML2)*

2. Ability for user to change their password.

3. Encrypted communications for all transactions.

4. Print reports and export to CSV file.

5. Access Control.

   a. Cardholder and group (add/modify/delete)

   b. Credential management (add/modify/delete)

   c. Access rules management (add/modify/delete)

   d. Visitor management (check-in/modify/check-out)

   e. Unlock door

   f. Override the unlocking schedule on a door

   g. Door Activities report

6. Alarms.

   a. Alarm report

7. Threat Level management.

8. Automatic License Plate Recognition (ALPR).

   a. Live monitoring of the ALPR cameras

   b. ALPR reads and hits report

   c. Addition of plate numbers to hotlists

2.24 SMARTPHONE AND TABLET APP GENERAL REQUIREMENTS

A. The USP shall support mobile apps for various off-the-shelf devices. The mobile apps shall communicate with the USP over any Wi-Fi or cellular network connection.

B. Mobile apps shall communicate with the USP via a Mobile Server Role (MSR). All communication between the mobile apps and MSR shall be based on standard TCP/IP protocol and shall use the TLS encryption with digital certificates to secure the communication channel.

C. Supported device manufacturers shall include (refer to Mobile App specifications for latest compatibility list):

D. Apple devices running iOS 11.0 or later

E. Android devices 6.0 or later

F. It shall be possible to download the mobile apps from the Central application store (Apple iTunes App Store, Google Play).

G. It shall be possible to push configuration to mobile devices through a Mobile Device Management solution such as VWWare Workspace One or Microsoft Intune.

H. Functionalities

1. Core

a. Ability to logon/logoff the UPS using an authorized use profile of the system.

b. Ability to support passive authentication from a single sign-on provider (OpenID Connect or SAML2 identity provider).

c. Ability to use biometric features (thumbprint, face ID, etc.) to perform connection to the system.

d. Ability to change the picture or the password of the user of the mobile app.

e. Ability to view the current Threat Level of the system.

f. Ability to change the current Threat Level of the system.

g. Ability to execute hot actions configured in the user profile.

h. Ability to view entities from the USP:

2. Cameras

3. Doors

4. ALPR cameras

5. Web Tile Plugins

6. Layouts

7. Camera Sequences

8. Macros

9. Maps (geographical maps only) *(Specifier, additional license required, Plan Manager Advanced)*
   a. Ability to navigate the system hierarchical view of the entities and search entities in the system.

10. Video

a. Ability to view live and recorded video from the cameras of the USP. A maximum of eight cameras shall be displayed.

b. Ability to view video in native format (H.264).

c. Ability to display live and recorded video side-by-side for a specific camera.

d. Ability to perform digital zoom on cameras.

e. Ability to perform actions on cameras, such as add a bookmark, control a PTZ, control the iris/focus function, save a snapshot, and start/stop recording.

f. Ability to view camera layouts.

g. Ability to view camera sequences.

h. Ability to run a camera events report.

i. Ability to change the video quality on the cameras displayed on the mobile app.

j. Ability to use the camera of the smartphone and stream a live video feed to a video recorder in the system

11. Access Control
    a. Ability to view the door state and the door lock state.

    b. Ability to perform actions on a door such as unlock the door, set the door in maintenance mode, and override the door unlocking schedule.

12. Automatic License Plate Recognition
    a. Ability to view live events raised by an ALPR camera.

    b. Ability to view the read image, context image, and all metadata captured by the ALPR camera.

    c. Ability to run an ALPR event report.

    d. Ability to add a license plate to a hotlist on the system.

13. Alarm Management
    a. Ability to receive push notifications to notify mobile operators that an alarm was received.

    b. Ability to view all active alarms assigned to the mobile operator.

    c. Ability to perform action on an alarm such as acknowledge, forward, or alternate-acknowledge an active alarm.

    d. Ability to view entities attached to the alarm.

14. Map *(Specifier, additional license required, Plan Manager Advanced)*
    a. Ability to display a geographical map with USP entities geo-located on the map.

b. Ability to view any entity configured on the map.

c. Ability to go to pre-defined map locations using preset buttons.

d. Ability to search for entities or locations on the map.

15. Incident management
    a. Ability to view active incidents, sort and group them for a customized view.

    b. Ability to trigger incidents manually.

    c. Ability to get all details about an incident including related incidents, entities and documents.

    d. Ability to take ownership of an incident and respond to the defined standard operating procedure geared towards incident resolution.

I. It shall be possible to send a message from the client user interface to a mobile operator.

J. It shall be possible to send a live or playback video sequence from the client UI to a mobile operator.

K. It shall be possible to view mobile operators who enabled location tracking on a map in the system. The location of the mobile operator should be updated in real time. *(Specifier, additional license required, Plan Manager Advanced)*

2.25 HEALTH MONITOR

A. The USP shall monitor the health of the system, log health-related events, and calculate statistics.

B. USP services, roles, agents, units, and client apps will trigger health events.

C. The USP shall populate the Windows Event Log with health events related to USP roles, services, and client apps.

D. A dedicated role, the Health Monitoring Role, shall perform the following actions:

1. Monitor the health of the entire system and log events.

2. Calculate statistics within a specified time frame (hours, days, months).

3. Calculates availability for clients, servers and video/access/ALPR units.

E. A Health Monitoring task and Health History reporting task shall be available for live and historical reporting.

F. A Health Monitoring dashboard task shall be available in the client application user interface to provide a live display, such as pie charts and event lists, for quick visual assessment on the general health of the system.

G. A web-based, centralized health dashboard shall be available to remotely view unit and role health events of the USP.

H. Detailed system care statistics will be available through a web-based dashboard providing health metrics of USP entities and roles, including Uptime and mean-time-between-failures.

I. All health events raised in the system can be used for automating the USP event/action management.

J. Health events shall be accessible via the SDK (can be used to create SNMP traps).

2.26 USP GENERAL REQUIREMENTS

A. The Unified Security Platform (USP) shall be an enterprise class IP-enabled security and safety software solution.

B. The USP shall support the seamless unification of IP access control system (ACS), IP video management system (VMS), and IP automatic license plate recognition system (ALPR) under a single platform. The USP user interface (UI) applications shall present a unified security interface for the management, configuration, monitoring, and reporting of embedded ACS, VMS and ALPR systems, and associated edge devices.

C. Functionalities available with the USP shall include:

1. Configuration of embedded systems, such as ACS, ALPR, and VMS systems.

2. Live event monitoring.

3. Live video monitoring and playback of archived video.

4. Alarm management.

5. Reporting, including creating custom report templates and incident reports.

6. The Federation™ feature for global monitoring, reporting, and alarm management of multiple remote and independent ACS, VMS, and or ALPR systems spread across multiple facilities and geographic areas*. (Specifier, Enterprise only, additional license required)*

7. Global cardholder management across multiple facilities and geographic areas each with their own independent ACS system. *(Specifier, Enterprise Only, additional license required for each site)*

8. Microsoft Active Directory integration for synchronizing USP user accounts and ACS cardholder accounts. *(Specifier, Professional and up, additional license required)*

9. Intrusion device and panel integration (live monitoring, reporting, and arming/disarming). *(Specifier, Professional and up, additional license required)*

10. SIP Intercom device integration for bi-directional communication. *(Specifier, all versions, additional license required)*

11. Integration with third party systems and databases via plug-ins (access control, video analytics, point of sale, and more). *(Specifier, Professional and up, additional license required)*

12. Dynamic graphical map viewing.

13. Asset management system integration. *(Specifier, Professional and up, additional license required)*

D. The USP shall be deployed in one or more of the following types of installations:

1. Unified access, ALPR, video platform, and any combination thereof.

2. Standalone access control, video, or ALPR platform.

3. Unified access and video platform that federates multiple remote ACS, VMS, and ALPR.

4. Standalone access control that federates multiple independent remote ACS.

E. Licensing:

1. A single central license shall be applied centrally on the configuration server.

2. There shall be no requirement to apply a license at every server computer or client workstation.

3. Based on selected options, one or more embedded systems shall be enabled or disabled.

F. Hardware and Software Requirements:

1. The USP and embedded systems (video, license plate recognition, and access control) shall be designed to run on a standard PC-based platform loaded with a Windows operating system. The preferred operating system shall be coordinated with the Owner following the manufacturer supported operating systems.

2. The core client/server software shall be built in its entirety using the Microsoft .NET software framework and the C# (C-Sharp) programming language.

3. The USP database server(s) shall be built on Microsoft's SQL Server. The preferred SQL version shall be coordinated with the Owner and compatible with the USP.

4. The USP shall be compatible with virtual environments, including VMware and Microsoft Hyper-V.

5. The USP shall use the latest user interface (UI) development and programming technologies such as Microsoft WPF (Windows Presentation Foundation), the XAML markup language, and .NET software framework.

2.27 USP ARCHITECTURE

A. The USP shall be based on a client/server model. The USP shall consist of a standard Server Software Module (SSM) and Client Software Applications (CSA).

B. The USP shall be an IP enabled solution. All communication between the SSM and CSA shall be based on standard TCP/IP protocol and shall use TLS encryption with digital certificates to secure the communication channel.

C. The SSM shall be a Windows service that can be configured to start when the operating system is booted and run in the background. The SSM shall automatically launch at computer startup, regardless of whether or not a user is logged on the machine.

D. Users shall be able to deploy the SSM on a single server or across several servers for a distributed architecture. The USP shall not be restricted in the number of SSM deployed.

E. The USP shall support the concept of The Federation feature whereby multiple independent ACS, VMS, and ALPR installations can be merged into a single large virtual system for centralized monitoring, reporting, and alarm management. *(Specifier, Enterprise only, additional license required)*

F. The USP shall protect against potential database server failure and continue to run through standard off-the-shelf solutions.

G. The USP shall support up to one thousand instances of CSA connected at the same time. However, an unrestricted number of CSA can be installed at any time. *(Specifier, Maximum 5 with Standard; Maximum 10 with Professional; Unrestricted with Enterprise)*

H. The USP shall support an unrestricted number of logs and historical transactions (events and alarms) with the maximum allowed being limited by the amount of hard disk space available.

I. Roles-Based Architecture:

1. The USP shall consist of a role-based architecture, with each SSM hosting one or more roles.

2. Each role shall execute a specific set of tasks related to either core system, automatic license plate recognition (ALPR), video (VMS), or access control (ACS) functionalities, among many others. Installation shall be streamlined through the ability of the USP to allow administrators to:
   a. Deploy one or several SSM across the network prior to activating roles.
   b. Activate and deactivate roles as needed on each and every SSM.
   c. Centralize role configuration and management.
   d. Support remote configuration.
   e. Move roles over from one SSM to another.

3. Each role, where needed, shall have its own database to store events and role-specific configuration information.

4. Roles without databases, such as The Federation feature, Active Directory, and Global Cardholder Management, shall support near real-time standby without any third party failover software being required.

5. Directory Role:
   a. The Directory Role shall manage the central database that contains all the system information and component configuration of the USP.

   b. The Directory Role shall authenticate users and give access to the USP based on predefined user access rights or privileges, and security partition settings.

   c. The Directory Role shall support the configuration/management of the following components common to the ACS, ALPR, and VMS sub-systems:

      i. Security Partitions, users, and user groups

      i. Areas

      ii. Zones, input/output (IO) linking rules, and custom output behavior

      iii. Alarms. Schedules, and scheduled tasks

      iv. Custom events

      v. Macros or custom scripts

   d. The Directory Role shall support the configuration/management of the following components specific to VMS:

      i. Video servers and their peripherals (for example audio, IOs, and serial ports)

      ii. PTZ

      iii. Camera sequences

      iv. Recording and archiving schedules

   e. The Directory Role shall support the configuration/management of the following components specific to ACS:

      i. Door controllers, and input and output (IO) modules

      ii. Doors, Elevators, and Access rules

      iii. Cardholders and cardholder groups, credentials, and badge templates

   f. The Directory Role shall support the configuration/management of the following components specific to ALPR:

      i. ALPR units and cameras

      ii. Hotlists, permit lists, and overtime rules

6. The Video Archiver Role shall be responsible for managing cameras and encoders under its control and archiving.

7. The Media Router Role shall be responsible for routing video and audio streams across local and wide area networks from the source (for example DVS) to the destination (for example CSA).

8. The Access Manager Role shall be responsible for synchronizing access control hardware units under its control, such as door controllers and I/O modules. This role shall also be responsible for validating and logging all access activities and events when the door controllers and I/O modules are online.

9. The Automatic License Plate Recognition (ALPR) Role shall be responsible for synchronizing fixed ALPR units (cameras) and mobile ALPR applications under its control. The ALPR Role shall also be responsible for logging all ALPR activities and events.

10. The Zone Manager Role shall be responsible for managing all software zones (collection of inputs) and logging associated zone events. Zones shall consist of inputs from both access control and video devices.

11. The Health Monitoring Role shall be responsible for monitoring and logging health events and warnings from the various client applications, roles, and services that are part of the USP. This role shall also be responsible for logging events within the Windows Event Log and for generating reports on health statistics and health history.

12. The Data Ingestion Role shall be responsible for ingesting data from external sources in order to enhance the system reporting and dashboarding capabilities.

13. Optional Roles
    a. The Federation Role shall be responsible for creating a large virtual system consisting of hundreds or thousands of independent and remote ACS, VMS, and/or ALPR systems. *(Specifier, Enterprise only, additional license required)*

    a. The Global Cardholder Synchronizer Role shall be responsible for synchronizing cardholder and credential data between the local site and a central site. Synchronization between remote sites shall also be supported. *(Specifier, Enterprise only, additional license required)*

    b. The Active Directory Role shall be responsible for synchronizing user accounts and cardholder accounts with a Microsoft Active Directory server. *(Specifier, Professional and up, additional license required)*

    c. The Intrusion Manager Role shall be responsible for managing third party intrusion devices such as alarm panels and perimeter detection devices. This role shall also be responsible for logging all intrusion events in a database. *(Specifier, Professional and up, additional license required)*

    d. The Asset Manager Role shall be responsible for integrating and synchronizing with third party asset management systems and logging asset related events. This role shall also be responsible for supporting the execution of asset-related reports such as inventory reports and asset activity reports. *(Specifier, Professional and up, additional license required)*

    e. The Plug-in Manager Role shall be responsible for the communication between the USP and third party systems such as video analytics, access control, video, ALPR, and building management systems. *(Specifier, Professional and up, additional license required)*

a. *(Specifier, Professional and up, additional license required)*

f. The Web SDK Role shall be responsible for connecting the USP to any application or interface developed with the Web Service SDK. Applications developed with the Web Service SDK shall be platform independent and rely on the REST protocol for communications. *(Specifier, Professional and up, additional license required)*

b. The Communication Management Role shall be responsible for registering the SIP communication endpoints and for managing the call routing. *(Specifier, all packages, additional license required)*

J. Server Monitoring Service (Watchdog):

1. The USP shall include a Server Monitoring Service that continuously monitors the state of the Server Software Module (SSM) service.

2. The Server Monitoring Service shall be a Windows service that automatically launches at system startup, regardless of whether or not a user is logged into his account.

3. The Server Monitoring Service shall be installed on all PCs/servers running an SSM. In the event of a malfunction or failure, the Server Monitoring Service shall restart the failed service. As a last resort, the Server Monitoring Service shall reboot the PC/server should it be unable to restart the service.

2.28 USP ACCESS CONTROL, VIDEO, AND ALPR UNIFICATION

A. The Monitoring UI shall present a true Unified Security Interface for live monitoring and reporting of the ACS, VMS, and ALPR. Advanced live video viewing and playback of archived video shall be available through the Monitoring UI.

B. The Configuration UI shall present a true Unified Security Interface for the configuration and management of the ACS, VMS, and ALPR.

C. The user shall be able to associate one or more video cameras to the following entity types: areas, doors, elevators, zones, alarms, intrusion panels, ALPR cameras, and more.

D. It shall be possible to view video associated to access control events when viewing a report.

E. It shall be possible to view video associated to intrusion panel events when viewing a report.

F. It shall be possible to view video associated to ALPR events when viewing a report.

2.29 USP ALARM MANAGEMENT

A. The USP shall support the following Alarm Management functionality:

1. Create and modify user-defined alarms. An unrestricted number of user-defined alarms shall be supported.

2. Assign a time schedule or a coverage period to an alarm. An alarm shall be triggered only if it is a valid alarm for the current time period.

3. Set the priority level of an alarm and its reactivation threshold.

4. Define whether to display live or recorded video, still frames or a mix once the alarm is triggered.

5. Provide the ability to display live and recorded video within the same video tile using picture-in-picture (PiP) mode.

6. Provide the ability to group alarms by source and by type.

7. Define the time period after which the alarm is automatically acknowledged.

8. Define the recipients of an alarm. Alarm notifications shall be routed to one or more recipients. Recipients shall be assigned a priority level that prioritizes the order of reception of an alarm.

9. Define the alarm broadcast mode. Alarm notifications shall be sent using either a sequential or an all-at-once broadcast mode.

10. Define whether to display the source of the alarm, one or more entities, or an HTML page.

11. Specify whether an incident report is mandatory during acknowledgment.

B. The workflows to create, modify, add instructions and procedures, and acknowledge an alarm shall be consistent for access control, ALPR, and video alarms.

C. Alarms shall be federated, allowing global alarm management across multiple independent USP, ACS, and VMS systems.

D. The USP shall also support alarm notification to an email address or any device using the SMTP protocol.

E. The ability to create alarm-related instructions shall be supported through the display of one or more HTML pages following an alarm event. The HTML pages shall be user-defined and can be interlinked.

F. Alarm unpacking and packing shall be supported where all the entities associated to an alarm can be display in the Monitoring UI with the single click of a button.

G. The user shall have the ability to acknowledge alarms, create an incident upon alarm acknowledgement, and put an alarm to snooze.

H. The user shall be able to spontaneously trigger alarms based on something he or she sees in the system.

I. An alarm shall be configured in such a way that it remains visible until the source condition has been acknowledged.

J. The user shall be able to investigate an alarm without acknowledging it.

2.30 USP THREAT LEVELS *(SPECIFIER, ENTERPRISE ONLY, ADDITIONAL LICENSE REQUIRED)*

A. The USP shall support Threat Levels to dynamically change the system behavior to respond to critical events.

B. Threat Levels shall be activated and deactivated by the CSA operator with the right privilege.

C. Threat Levels shall be set on an area or on the entire system.

D. Threat Levels shall affect the system behavior by executing any action available in the USP such as: trigger output, start recording, block camera, override recording quality, arm zone, set a door in maintenance mode, and more.

E. The following specific actions shall be available with Threat Level:

1. Set minimum security clearance to restrict or permit access to cardholders on specific areas on top of the restrictions imposed by the access rules.

2. Set minimum user level to automatically log out user from the USP.

3. Set reader mode to change how the doors are accessed (for example card and PIN, or card or PIN).

F. A visible notification shall be displayed in all operator CSA when a Threat Level is activated.

2.31 USP ADVANCED TASK MANAGEMENT

A. USP shall support an infrastructure for managing Monitoring UI tasks used for live monitoring, day-to-day activities, and reporting.

B. Administrators shall be able to assign tasks and lock the operator’s workspace. The user management of their workspace shall be limited by their assigned privileges.

C. Operators shall be able save their tasks as either Public tasks or Private tasks and in a specific partition. Public tasks shall be available to all users. Private tasks shall only be available to the owner of the task.

D. Operators shall be able to share their tasks by sending them to one or more online users. Recipients shall have the option to accept the sent task.

E. Operators shall be able to duplicate a task.

2.32 USP REPORTING

A. The USP shall support report generation (database reporting) for access control, ALPR, video, and intrusion.

B. Each and every report in the system shall be a USP task, each associated with its own privilege. A user shall have access to a specific report task if they have the appropriate privilege.

C. The workflows to create, modify, and run a report shall be consistent for access control, ALPR, and video reports.

D. Reports shall be federated, allowing global consolidated reporting across multiple independent USP, ACS, VMS, and ALPR systems.

E. Access control and ALPR reports shall support cardholder pictures and license plate pictures, respectively.

F. The USP shall support the following types of reports:

1. Alarm reports

2. Video-specific reports (archive, bookmark, motion, and more)

3. Configuration reports (cardholders, credentials, units, access rules, readers/inputs/outputs, and more)

4. Activity reports (cardholder, cardholder group, visitor, credential, door, unit, area, zone, elevator, and more)

5. ALPR-specific reports (mobile ALPR playback, hits, plate reads, reads/hits per day, reads/hits per ALPR zone, and more)

6. Health activity and health statistics reports

7. Other types of reports, including visitor reports, audit trail reports, incident reports, and time and attendance reports

G. Generic Reports, Custom Reports and Report Templates:

1. The user shall the option of generating generic reports from an existing list, generating reports from a list of user-defined templates, or creating a new report or report template.

2. The user shall be able to customize the predefined reports and save them as new report templates. There shall be no need for an external reporting tool to create custom reports and report templates. Customization options shall include setting filters, report lengths, and timeout period. The user shall also be able to set which columns shall be visible in a report. The sorting of reported data shall be available by clicking on the appropriate column and selecting a sort order (ascending or descending).

3. All report templates shall be created within the Monitoring UI.

4. These templates can be used to generate reports on a schedule in PDF or Excel formats.

5. An unrestricted number of custom reports and templates shall be supported.

H. A reporting task layout shall consist of panes with settings (report length, filters, go and reset commands, etc.), the actual report data in column format, and a pane with display tiles. The user shall be able to drag and drop individual records in a report onto one or more display tiles to view a cardholder's picture ID, playback a video sequence, or an ALPR event.

I. The USP shall support comprehensive data filtering for most reports based on entity type, event type, event timestamp, custom fields, and more.

J. The reporting task shall have the ability to display results through graphics such as line charts, bar charts, stacked bar charts, doughnut charts, and pie charts.

K. The user shall be able to click on an entity within an existing report to generate additional reports from the Monitoring UI.

L. The USP shall support the following actions on a report: print report, export report to a PDF/Microsoft Excel/CSV file, export the graphics chart in JPG/PNG, and automatically email a report based on a schedule and a list of one or more recipients.

2.33 USP DASHBOARDS

A. The USP shall support the ability to create dashboards.

B. Operators shall be allowed to view dashboards if they are granted the appropriate privilege. Modification to the dashboards should also be allowed to users granted the appropriate privilege.

C. Dashboards in the system shall be a USP task. A user shall have access to a specific dashboard task if they have the appropriate privilege.

D. Dashboards shall be shaved either in a private folder or a public folder.

E. A dashboard shall consist of a canvas with various widgets displayed on the canvas. All widgets should offer the ability to specify location and size to the widget, a title to the widget, a background color to the widget, and the ability to refresh periodically the content of the widget.

F. Dashboard widget types shall be:

1. Image: provides the ability to display an image (JPG, PNG, GIF, BMP) on a dashboard.

2. Text: provides the ability to display a text on a dashboard. The text style shall be configurable, so font, size, color, and alignment can be specified by the user.

3. Tile: provides the ability to display any entity of the USP inside of a tile.

4. Web page: provides the ability to display a URL on a dashboard.

5. Entity Count: provides the ability to display the total number of a specific entity type in the USP.

6. Reports: provides the ability to display the results of any saved reports in the system. The results shall be displayed either by showing the total number of results in the report, a set of top results from the report, or a visual graph from the data returned by the report.

G. It shall be possible to extend the widgets of a dashboard using the SDK. This will provide the ability to develop custom widgets to the system.

H. The USP shall support the following actions on a dashboard: print dashboard, export dashboard to PNG file, and automatically email a report based on a schedule and a list of one or more recipients.

2.34 USP Federation feature: Monitoring of Remote Systems *(Specifier, Enterprise only, additional license required for each federated sites and entities)*

A. The USP shall support the concept of a Federation feature for access control, video, and ALPR.

B. The Federation feature shall allow multiple independent USP systems (Federated systems) to be unified into a larger virtual system (the Federation feature). This shall facilitate the global monitoring of multiple independent USP systems.

C. The Federation feature shall support the unification of multiple independent video surveillance systems or VMS.

D. The Federation feature shall support the unification of multiple independent access control systems or ACS.

E. The Federation feature shall support the unification of multiple independent license plate recognition systems or ALPR.

F. Entities that shall federated and monitored centrally from the Federation feature shall include alarms, areas, cameras, cardholders and cardholder groups, credentials, doors, elevators, ALPR events, and zones (monitored inputs).

G. The Federation feature shall support a cloud-based deployment, whereby the service and infrastructure will be updated automatically and provisioned by the service provider, without need for on-site hardware.

H. The Federation feature shall support Global Alarm Management from the Monitoring UI for access control, video, and ALPR.

I. The Federation feature shall support Global Report Generation from the Monitoring UI for access control, video, and ALPR.

J. The Federation feature shall support dozens of operator actions on remote (federated) entities from the Monitoring UI (for example generating a global report taking into account events from multiple independent sites or acknowledging remote alarms).

2.35 USP ZONE MANAGEMENT

A. The USP shall support the configuration and management of zones for input point monitoring via the Zone Manager Role. A user shall be able to add, delete, or modify a zone if they have the appropriate privileges.

B. A zone shall monitor the status of one or more inputs points. Zone monitoring or input point monitoring shall be possible through the use of a controller and one or more input modules. Inputs from video cameras or video encoders shall also be accessible via a zone.

C. Depending on the hardware installed, supervised inputs shall be supported. Depending on the input module used, both 3-state and 4-state supervision shall be available.

D. A schedule shall be defined for a zone, indicating when the zone will be monitored.

E. Custom Events shall provide full flexibility in creating custom events tailored to a zone. Users shall be able to associate custom events to state changes in monitored inputs.

F. The ACS shall support one or more cameras per zone. Video shall then be associated to zone state changes.

G. Input/Output (IO) Linking

1. Zone management shall support Input/Output (IO) Linking. I/O Linking shall allow one or more inputs to trigger one or more outputs.

2. I/O Linking shall be available in offline mode when communication between the server and hardware is not available.

3. Custom Output Behaviors shall provide full flexibility in creating a variety of complex output signal patterns: simple pulses, periodic pulses, variable duty-cycle pulses, and state changes.

4. Through the “trigger an output” action, the ACS shall support the triggering of outputs with custom output behaviors.

2.36 USP USER AND USER GROUP SECURITY, PARTITIONS, AND PRIVILEGES MANAGEMENT

A. The USP shall support the configuration and management of users and user groups. A user shall be able to add, delete, or modify a user or user group if they have the appropriate privileges.

B. The USP shall support user authentication with claims-based authentication using external providers. External providers shall include:

1. ADFS (Active Directory Federation Services)

2. Azure Active Directory (through OpenID Connect)

3. Ping Identity (through OpenID Connect)

4. KeyCloak (through OpenID Connect)

5. Other Open ID Connect / SAML2 authentication agents

C. Common access rights and privileges shared by multiple users shall be defined as User Groups. Individual group members shall inherit the rights and privileges from their parent user groups. User group nesting shall be allowed.

D. User privileges shall be extensive in the USP. All configurable entities for the USP, including access control, video, and ALPR shall have associated privileges.

E. Specific entities, such as cardholders, cardholder groups, and credentials shall include a more granular set of privileges, such as the right to access custom fields and change the activation or profile status of an entity.

F. Partitions:

1. The USP shall limit what users can view in the configuration database via security partitions (database segments). The administrator, who has all rights and privileges, shall be allowed to segment a system into multiple security partitions.

2. All entities that are part of the USP can be assigned to one or more partitions.

3. A user who is given access to a specific partition shall only be able to view entities (components) within the partition to which they have been assigned. Access is given by assigning the user as an accepted user to view the entities that are members of a particular partition.

4. A user or user group can be assigned administrator rights over the partition.

G. It shall be possible to specify user and user group privileges on a per partition basis.

H. Advanced logon options shall be available such as dual logon and more.

I. It shall be possible to specify an inactive period for the Monitoring UI after which time the application shall automatically lock, while still preserving access to currently displayed camera feeds.

J. It shall be possible to review used permissions and determine:

1. For any entity in the system, which user group or user can view or modify it.

2. For any user group or user in the system, what are its privileges.

3. For any privilege in the system, which used group or used is allowed to perform the underlying action.

2.37 USP EVENT/ACTION MANAGEMENT

A. The USP shall support the configuration and management of events for video and ALPR. A user shall be able to add, delete, or modify an action tied to an event if he has the appropriate privileges.

B. The USP shall receive all incoming events from one or more ACS, VMS, and/or ALPR. The USP shall take the appropriate actions based on user-define event/action relationships.

C. The USP shall receive and log the following events:

1. System-wide events

2. Application events (clients and servers)

3. Area, camera, door, elevator, and ALPR events (reads and hits)

4. Cardholder and credential events

5. Unit events

6. Zone events

7. Alarm events

8. ALPR events

9. First Person In and Last Person Out events and antipassback events

10. Intrusion events

11. Asset management events

12. Health monitoring events.

D. The USP shall allow the creation of custom events.

E. The USP shall have the capability to execute an action in response to an access control, video, and ALPR event.

F. The USP shall allow a schedule to be associated with an action. The action shall be executed only if it is an appropriate action for the current time period.

2.38 USP SCHEDULES AND SCHEDULED TASKS

A. Schedules

1. The USP shall support the configuration and management of complex schedules. A user shall be able to add, delete, or modify a schedule if they have the appropriate privileges.

2. The USP shall provide full flexibility and granularity in creating a schedule. The user shall be able to define a schedule in 1-minute or 15-minute increments.

3. Daily, weekly, ordinal, and specific schedules shall be supported.

B. Scheduled Tasks

1. The USP shall support scheduled tasks for access control, video, and ALPR.

2. Scheduled tasks shall be executed on a user-defined schedule at a specific day and time. Recurring or periodic scheduled tasks shall also be supported.

3. Scheduled tasks shall support all standard actions available within the USP, such as sending an email or emailing a report.

2.39 USP MACROS AND CUSTOM SCRIPTS

A. The USP shall enable users to automate and extend the functionalities of the system through the use of macros or custom scripts for access control, video, and ALPR.

B. Custom macros shall be created with the USP Software Development Kit (SDK).

C. A macro shall be executed either automatically or manually.

D. In the Monitoring UI, a macro shall be launched through hot actions.

2.40 USP DYNAMIC GRAPHICAL MAPS (DGM)

A. The USP shall support mapping functionality for access control, video surveillance, intrusion detection, ALPR, and external applications.

B. The USP shall provide a map centric interface with the ability to command and control all the USP capabilities from a full screen map interface.

C. It shall be possible to span the map over all screens of the USP client station. In the scenario where the map is spanned over all the screens of the USP client station it shall be possible to navigate the map including pan and zoom, and the map's moves shall be synchronized between all screens. Spanning the map over multiple screens must provide the same command and control capabilities than in a single screen display.

D. The DGM shall support the following file format and protocol for importing map background:

1. PDF

2. JPG

3. PNG

4. Web Tile Map Service (WMTS) and Web Map Service (WMS) defined by the Open Geospatial Consortium (OGC)

5. BeNomad

6. AutoCAD (DWG & DXF)

E. The DGM shall provide the following online map providers for use as map background and provide the ability to manage their service license if they require one:

1. Google Map, aerial, terrain (Licensed)

2. Bing Map, aerial, satellite, hybrid (Licensed)

3. ESRI ArcGIS (Licensed)

4. OpenStreet Map aerial (Licensed)

5. OVI hybrid

F. It shall be possible to configure a mixed set of maps made of GIS, online providers and private imported files and link them together.

G. The DGM shall provide the ability to display all native entities of the USP including:

1. Cameras, fix, and PTZ
2. Doors
3. Camera sequences
4. Areas
5. Intrusion areas
6. Intrusion zones
7. License Plate Recognition cameras
8. Digital inputs
9. Digital outputs
10. Intercoms
11. Alarms
12. Macros
13. Police Car Patrollers

H. The DGM shall provide the ability to draw and display information over the map in the form of:

1. Vectoral shapes: line, rectangles, polygons, ellipse
2. Pictures
3. Text

I. The DGM shall provide the ability to display any type of third party entities integrated through an SDK. (Specifier, Plan Manager Standard and up, additional license required)

J. The DGM shall provide the ability to display layer of information in Keyhole Markup Language (KML) format.

K. The DGM shall provide the ability to the operator to manage layers of entities displayed over the map, being able to turn them on and off and changing the superposition order.

L. The DGM shall provide the ability to import data layers from one or more ESRI ArcGIS servers.

M. The DGM shall provide the operators with the ability to manage layers that are imported from ESRI ArcGIS. The operators shall be able to turn the layers on and off, as well as sort the layers.

N. The DGM shall offer built-in map data backup and restore for both map backgrounds and layers of entities.

O. The DGM shall provide the ability to import configurations from an external file such as:

1. AutoCAD layer for objects

2. CSV, Excel file

P. The DGM shall offer failover capabilities.

Q. The DGM shall scale up to several thousands of entities on a single map and hundreds of maps.

R. The DGM shall provide a means to update a map background without affecting the map object configuration.

S. The DGM shall offer a user-friendly graphical map designer to configure the maps.

T. The DGM shall provide user friendly and intuitive navigation that includes:

1. The ability to create hierarchies of maps to facilitate navigation within and between various sites and buildings.

2. The ability to define favorites for recurrent position recall.

3. The possibility to create links between maps. The map links shall allow the link from one map to multiple maps representing the floors of a building. Navigating between floors of a building shall keep the level of the map.

4. A common user experience regarding navigation into the map for both GIS and private maps. *(Specifier, Plan Manager Advanced required for GIS)*

U. It shall be possible to monitor the state of entities on the map. It shall be possible to customize the icons of any entities represented on the map.

V. The DGM shall offer the ability to optionally set a graphical display notification of the motion detection.

W. The DGM shall offer a smart selection tool to access the video. By clicking the location the user wants to see, the DGM will automatically select the cameras that can see this location and move the PTZ towards that location. This smart selection tool shall take obstacles into consideration and not display cameras that cannot see the location because of a wall.

X. It shall be possible to select a location by drawing a zone of interest on the DGM, and to display all the entities that are part of that zone of interest at once.

Y. The user shall be able to select and display the content of multiple USP entities on the map in pop-up windows.

Z. The user shall be able to move, resize, and pin the USP entity pop-up windows to the map.

AA. It shall be possible to access live and playback video from the map.

BB. It shall be possible to monitor all entity event notifications from the DGM. Users shall be able to turn notifications on and off per entity.

CC. The DGM shall offer the ability to fully operate alarm monitoring. It shall be possible to:

1. Center the map on entities related to the alarm.

2. Visualize the Alarm notifications on the map and access the related videos from the map.

3. Trigger and receive alarms.

4. Act on the alarm from the DGM, including acknowledgements, forwarding, and investigation.

5. Visualize that an alarm occurred in an underlying linked map.

DD. The DGM shall provide the following search capabilities:

1. Search and center by entity name.

2. From the Display of an entity in the USP, locate the entity on the map and offer the ability to select another one close-by.

3. By street address, city, landmark, point of interest (using geocoder license from Google, ESRI, or other provider).

EE. Any update of map content by an administrator shall be immediately and dynamically pushed to all DGM users.

FF. The DGM shall support the use of GIS maps or private maps or a combination of both for map background. *(Specifier, Plan Manager Advanced required for GIS)*

GG. The DGM shall be compatible with any GIS compliant maps with the OGC and supporting WMTS and WMS. This includes, but is not limited to, ESRI maps. The DGM shall allow the selection of the appropriate GIS layers. *(Specifier, Plan Manager Advanced required for GIS)*

HH. The DGM shall provide an intuitive built-in map designer for entity positioning on the map using drag and drop. Any configuration shall be graphic.

II. It shall be possible to edit and configure multiple map objects at once.

JJ. All map design modifications shall be logged in an audit trail.

KK. Various actions shall be available within maps for execution through simple and intuitive double-click, right-click, or drag-and-drop functionality. Examples of actions available through maps shall include unlocking a door and acknowledging an alarm.

LL. Through the following functionality, the DGM shall allow the management of USP alarms from the map: *(Specifier, Plan Manager Standard and up, additional license required)*

1. Locate on the map entities related to the alarm.

2. Display entities of the alarm with a specific icon, color, transparency level, and blinking rate.

3. List, select, and locate alarms.

4. Auto center the map on the highest priority alarm.

5. Handle the alarm from the map, including acknowledgement, forwarding, and investigation.

6. All map containers, such as hotspots or map links shall reflect the alarm status of the contained entities.

MM. It shall be possible to add advanced functionality to maps object using the SDK. Any functionality available through the USP SDK shall be available within maps. *(Specifier, Plan Manager Standard and up, additional license required)*

NN. The DGM shall offer lasso tools for:

1. Displaying entities at one location through a single action.

2. Triggering an action on all entities at one a location in a single click.

3. Editing multiple entities at one location simultaneously.

OO. The DGM shall allow the display of USP entities selected from the map on a remote monitor (video wall). *(Specifier, Plan Manager Standard and up, additional license required)*

PP. The DGM shall provide the ability to search within the map by entity name.

QQ. The DGM shall allow the use of KML overlay map information for both GIS and private maps. Movable objects shall be supported using KML. *(Specifier, Plan Manager Advanced only, additional license required)*

RR. The Contractor shall provide licenses for each entity that is required to be shown on the graphical maps. *(Specifier, licenses are sold in packs based on quantity of entities, specify a site license or unlimited after 1,000 entities)*

2.41 USP AUDIT AND USER ACTIVITY TRAILS (LOGS)

A. The USP shall support the generation of audit trails. Audit trails shall consist of logs of operator/administrator additions, deletions, and modifications.

B. Audit trails shall be generated as reports. They shall be able to track changes made within specific time periods. Querying on specific users, changes, affected entities, and time periods shall also be possible.

C. For entity configuration changes, the audit trail report shall include detailed information of the value before and after the changes.

D. The USP shall support the generation of user activity trails. User activity trails shall consist of logs of operator activity on the USP such as login, camera viewed, ALPR event viewed, badge printing, video export, and more.

E. The ACS shall support the following actions on an audit and activity trail report: print report and export report to a PDF/ Microsoft Excel/CSV file.

2.42 USP INCIDENT REPORTS

A. Incident reports shall allow the security operator to create reports on incidents that occurred during a shift. Both video-related and access control-related incident reports shall be supported.

B. The operator shall be able to create standalone incident reports or incident reports tied to alarms.

C. The operator shall be able to link multiple video sequences to an incident, access them in an incident report, and change the date or time of the sequences later on.

D. It shall be possible to create a list of Incident categories, tag a category to an incident, and filter the search with the category as a parameter.

E. Incident reports shall allow the creation of a custom form on which to input information on an incident.

F. Incident reports shall allow entities, events, and alarms to be added to support at the report's conclusions.

G. Incident reports shall allow the use of a custom logo, the default Mission Control logo or no logo at all.

2.43 USP DATA INGESTION

A. USP shall allow the possibility to import external data from outside sources to enhance unification of data sources within the USP.

B. Each data source shall be defied by a set of fields and field types that describe the data source. Field types shall be:

1. String

2. 32-bit and 64-bit integer

3. Floating point number

4. Boolean

5. Timestamp

6. Binary (in a file or base 64)

C. The visualization of each data point from a data source shall be configurable to determine what fields from the data should be displayed. The configuration of each field should be:

1. Which fields are displayed or hidden

2. What order are the fields displayed

3. A label to specify the name of the filed (to have a key:value format)

4. An option to specify how to display the field (text value, image, clipboard value, hyperlink to a web page, hyperlink to an entity in the system, sound file)

D. A privilege should be available for each data source to allow or deny access to specific users aand user groups of the USP.

E. Ingested data shall be available in the USP reporting system.

F. Ingested data shall be available to display in the USP dashboards.

2.44 USP THIRD PARTY INTEGRATION

A. Microsoft Active Directory Integration: *(Specifier, Professional and up, additional license required)*

1. The USP shall support a direct connection to one or multiple Microsoft Active Directory server via the Active Directory Role(s). Active Directory integration shall enable the synchronization of information from the Active Directory server to the USP.

2. Active Directory integration shall permit the central management of the USP users, user groups, cardholders, and cardholder groups.

3. The USP shall support ADFS for user login.

4. The USP shall be able to connect to and synchronize data from multiple Active Directory servers (up to 10).

5. The USP shall support Azure AD for cardholder synchronization.

6. The USP shall support synchronizing Active Directory Universal Groups as well as security groups belonging to other domains within the same forest.

7. The USP shall support Microsoft Active Directory encryption using LDAP SSL.

8. When enabled, Active Directory shall manage user logon to the USP client applications through the user's Windows credentials. Logging on to the USP shall utilize native Active Directory password management and authentication features.

9. It shall be possible to synchronize the following USP entities and their information from Active Directory with the USP:
   c. Users (username, first and last names, email address, and more)

   d. User groups (user group name, description, and group email address)

e. Cardholders (first and last names, description, email, picture and more)

f. Cardholder groups (cardholder group name, description, and group email address)

g. Active Directory attributes to USP custom fields

10. When enabled, the addition, removal, or suspension of a user's Windows account in Active Directory shall result in the creation, deletion, or disabling of the equivalent user account in the USP.

11. When enabled, the addition, removal, or suspension of a user's Windows account in Active Directory shall result in the creation, deletion, or disabling of the equivalent cardholder account in the USP.

12. Supported synchronization methods for additions, modification, and deletions of synchronized entities shall include on first logon (users only), manual synchronization, and scheduled synchronization.

13. The USP shall support user connections across independent organizations by connecting to an external identity provider using claims-based authentication such as ADFS (Active Directory Federation Services), Azure Active Directory, other OpenID Connect & SAML2 providers.

B. Intrusion Detection Integration: *(Specifier, Standard, Professional and up, additional license required - for an extended list, refer to the Supported Plugins in Security Center document)*

1. The USP shall integrate with third party intrusion panels and devices via an Intrusion SDK. The Intrusion Manager Role shall manage communications with the intrusion panels. Communications with intrusion devices shall be over serial communications and/or an IP network.

2. Integration with intrusion panels shall be possible outside the release cycle of the USP. It shall be possible to add new integrations at any point in time.

3. Functionality available via the integration of intrusion devices with the USP shall include the following (where supported by the intrusion panel):
   a. Arm and disarm intrusion devices (manually, on schedule, or following a USP event)

   b. Activate or trigger intrusion device outputs

   c. View intrusion events and alarms

   d. Monitor the status, including arming status, of the intrusion devices

   e. Video verification of intrusion events and alarms with video panels

   f. Create USP zones using intrusion device inputs

4. Currently supported intrusion panels include:
   a. Bosch G Series panels

   b. Bosch Map 5000

c. DSC Power Series panels

d. DMP XR Series panels

e. Honeywell Galaxy Dimension and Flex panels

f. Vanderbilt SPC

g. UTC Advisor Master and Advanced

5. Additional intrusion devices supported include:
   a. Buytime

   b. Alarm Panel Receiver

   c. Southwest Microwave RPMII

C. Third Party Access Control Systems: *(Specifier, Professional and up, additional license required, for extended list please refer to the Security Center supported Plugins guide)*

1. The USP shall integrate with third party access control software via the SDK. Communications with access control software shall be over an IP network, and should not support administrative tasks such as cardholder management.

2. Integration with access control software shall be possible outside the release cycle of the USP. It shall be possible to add new integrations at any point in time.

3. Functionality available via the integration of access control software with the USP shall include the following (where supported by the access control solution):

   a. Synchronize access control entities and receive associated events and states within the USP, including:
      1) Cardholders and access rights
      2) Visitors
      3) Readers and doors
      4) Alarms
      5) Inputs and outputs
   d. Monitor access control events

   e. Monitor and acknowledge access control alarms

   f. Trigger actions and outputs in the access control software using hot actions and event-to-actions

   g. Lock and unlock doors in the access control software

   h. Video verification of access control events and alarms

   i. Configure event-to-actions using the access control events and alarms

   j. Generate Security Center reports using the access control data

   k. View and monitor states of door entities in the USP maps

2. Currently supported access control manufacturers include:
    a. Tyco Software CCURE
    b. UTC Lenel Onguard
    c. Amag Symmetry
    d. Siemens Sipass
    e. AssaAbloy ARX

D. Third Party Destination Dispatch Systems: *(Specifier, Professional and up, additional license required, for extended list please refer to the Security Center supported Plugins guide)*

1. The USP shall integrate with third party destination dispatch (elevator control) software via the SDK. Communications with destination dispatch software shall be over an IP network.

2. Integrating with destination dispatch software shall be possible outside the release cycle of the USP. It shall be possible to add new integrations at any point in time.

3. Functionality available via the integration of destination dispatch software with the USP shall include the following (where supported by the destination dispatch solution):
    a. Destination dispatch entity creation and reception of associated events and state within the USP, including:
        i. Floors and landings
        ii. Elevator cars (front/rear doors) and kiosks
        iii. Cardholders and credentials (if applicable)
    b. Monitor destination dispatch events.
    c. Trigger manual dispatch actions.
    d. Video verification of destination dispatch events.
    e. Configure event-to-actions using the destination dispatch events.
    f. Generate Security Center reports using the destination dispatch data.
    g. Support multiple readers:
        i. Kiosk internal readers
        ii. USP readers
    h. Kiosk advanced modes and passenger types.
2. Currently supported destination dispatch manufacturers include:
    a. Otis Compass
    b. Thyssenkrupp
    c. Schindler

d. MCE

E. Asset Management Integration: *(Specifier, requires an additional license, Professional and up)*

1. The USP shall integrate with third party asset management systems via the Asset Management Role.

2. Communications with asset management solutions shall be over an IP network (via software communications).

3. Functionality available via the integration of asset management systems with the USP shall include the following (where supported by the asset management systems):

a. Synchronize asset management system assets with USP asset entities.

b. Live monitoring of asset-related activity events, health events, and activity (asset online, asset offline, asset moves, or low battery).

c. Synchronization of asset management alarms with Security Center alarms.

d. Viewing video tied to asset-related activity and alerts within monitoring and reporting tasks.

e. Acknowledging alarms in Security Center which acknowledges alerts in the asset management system and vice versa.

f. Real-time tracking of asset locations on a per area basis.

g. Asset Management Inventory reporting task that details the current location (area) of an asset.

h. Asset Activity reporting task that provides a historical review of asset-related events and activity.

4. Currently supported asset management systems include:

a. Deister Key management

b. Morsewatchmans

c. TRAKA

F. Additional Third Party Integrations

1. The USP shall support multiple approaches to integrating third party systems. These shall include: Software Development Kits (SDKs), REST-based Web Service SDKs, RTSP Service SDKs, and more. *(Specifier, Professional and up, SDK package and license required)*

2. The USP architecture shall support the addition of new connectors to integrate to third party system integration, such as: *(Specifier, refer to the website for how these are licensed, for an updated list of available Third Party Integrations, please refer to the supported plugin guide)*

a. Third party video systems

b. Third party access control systems

c. ALPR integrations with pay stations, permit vendors, pay-by-phone vendors, and ticketing vendors

d. Building management systems

e. Access Control ecosystem (such as IDscanner, card synchronization, Guardtour, Morpho Biometrics)

f. Transaction monitoring (POS, Barcode scanning, ATM)

g. Industrial IoT (Modbus, BACnet, OPC, SNMP)

h. Industrial Protocol Interface (BACnet, Modbus)

i. Videowall (Barco, Eizo)

j. Human resource management systems (HRMS)

k. Autonomous Drone Integration

l. Intelligent Keys (Salto SVN, Medeco XT, CLIQ)

m. Gunshot Detection (Shot Spotter, Guardian GunShot)

n. Dynamic Logbook

o. Facial Recognition Framework

p. Real-time Location Services - RTLS (HID)

2.45 USP SOFTWARE DEVELOPMENT KIT (SDK) *(SPECIFIER, PROFESSIONAL AND UP, ADDITIONAL LICENSE REQUIRED)*

A. A USP SDK shall be available to support custom development for the platform.

B. The SDK shall include functionalities specific to the embedded automatic license plate recognition (ALPR), access control (ACS), and video (VMS) systems.

C. Integration with external applications and databases shall be possible with the SDK.

D. The SDK shall support an API to allow third party access control hardware integration.

E. The SDK shall enable end-users to develop new functionality (user interface, standalone applications, or services) to link the USP to third party business systems and applications such as Badging Systems, Human Resources Management Systems (HRMS), and Enterprise Resource Planning (ERP) systems.

F. The SDK shall be based on the .NET framework.

G. The SDK shall support dynamic or transactional updates to the USP configuration. It shall also support change notification of USP entity configuration.

H. The SDK shall provide an extensive list of programming functions to view and/or configure core entities such as: users and user groups, alarms, custom events, and schedules, and more.

I. The SDK shall provide an extensive list of programming functions to view and configure ACS, VMS, and ALPR.

J. The SDK shall provide an extensive list of programming functions to view and configure most ACS entities such as cardholders, cardholder groups, visitors, credentials, access rules (modify only), and custom fields.

K. The SDK shall be able to receive real time events from the following USP entities: users and user groups, areas, zones, cameras, video units, doors, door controllers (units), elevators, cardholders, cardholder groups, and credentials.

L. The SDK shall be able to query the history of events for areas, cameras, zones, alarms, cardholders, credentials, visitors, doors, query license plate read events, license plate hit events, generate a license plate hits report, generate a license plate reads report.

M. The SDK shall support the following alarm functions: view alarms in real time, acknowledge alarms, change priority, and change recipient.

2.46 PHYSICAL IDENTITY AND ACCESS MANAGEMENT SYSTEM (PIAM)

A. The PIAM shall be an enterprise class Physical Identity and Access Management System. It shall fully integrate within a Unified Security Platform (USP). The USP shall allow the seamless integration of the PIAM with an Access Control System (ACS).

B. The PIAM system shall be highly scalable for global deployments.

1. The PIAM system to support configurations with multiple Access Control systems.

2. The PIAM system shall support licensing up to:

a. 1,000,000 unique identities

b. 500 sites

c. 1,000 visitor kiosks

d. 1,000,000 visits yearly

3. Additionally, each account shall support up to:

a. 10,000 roles, with up to 100,000 identities in one role

b. 200,000 areas

4. The PIAM system shall support a variety of identity management functionalities, including but not limited to:

a. Programmable management of cardholders for automatic access assignment

b. Manual management of cardholders via workflows

C. Manufacturer:

1. Genetec ClearID

D. Certification:

1. The PIAM system shall be an ISO/IEC 27001:2013 certified Information Security Management System.

2.47 ARCHITECTURE

A. Globally distributed cloud architecture:

1. Microsoft Azure

a. Distributed global services
1) Policies and rules
2) User authentication
3) Area management
4) API
5) Self-service portal
6) Workflows engine
7) Email notification
8) Automatic provisioning

b. Regional Services
1) Identities and cardholder credentials are stored at the closest Azure datacenter to the user.
2) Data is distributed across siloed, independent repositories.

c. Local sites
1) Security Center Synergis™
2) Local custom fields
3) Plugins

d. High availability
1) 99.9% SLA
2) Geo-redundant data storage

2. Security Controls

a. Data encryption
1) AES 256

2) RSA 2048
3) Symmetric keys and asymmetric keys
   a) Keys are managed using Azure Key Vault
   b) FIPS 140-2 Level 2 validated HSMs

b. Data integrity
   1) Digital signatures based on SHA 512 with RSA 2048 are used to validate data.

c. Communication encryption
   1) Hypertext Transfer Protocol Secure (HTTPS) protocol TLS 1.2
   2) Transport Layer Security (TLS) certificates

d. Zero-trust architecture
   1) Customer data is segmented into microservices, which only have the minimum data access requires to perform that task.
   2) All communication between microservices is encrypted and digitally signed.

e. Service monitoring
   1) Controls are updated based on various security threat feeds and services.
   2) System is running constant metrics analysis, including synthetic transactions to emulate user activity.
   3) Systems are monitored by and notify development and operations teams of any issues.

f. User authentications
   1) Azure Active Directory (AD) B2B by default
   2) Option for federation of existing AD user identities through Azure AD B2B or OpenID Connect to provide Single Sign-On (SSO).
   3) Also support:
   4) OneLogin
   5) Okta
   6) Auth0
   7) Ping
   8) MyID

3. Clear ID Plugin

   a. Installed on a Security Center server to integrate Genetec ClearID and Security Center, providing communications between Synergis™ and ClearID Cloud Services.

   b. Plugin is also installed on a Config Tool workstation, which allows that administrator to create and configure the plugin role, and configure database settings and connection settings for ClearID.

   c. Plugin will update automatically if an internet connection is available when a new release is published by Genetec.

2.48 MANAGEMENT

A. Identity management

1. Identity Information:

    a. General personal information

    b. Company information

    c. Supervisors for this identity

    d. System shall synchronize identity information with the following sources:
        1) CSV file exported from and HR database
        2) SQL Server or Oracle database
        3) Microsoft Active Directory via LDAP

    e. System shall have externally available Identity REST API for synchronization of identity information from external sources

2. Access Control

    a. Access period
        1) Date of activation
        2) Date of expiration

    b. Provisioning attributes

    c. Associated cardholders

3. User Permissions

    a. Administrator can enable or disable user access to web portal

    b. Administrator can assign user types:
        1) Administrator
        2) User

4. Visitor Management

    a. Administrator can grant user permissions to invite visitors to specific sites

B. Area Management

1. Area Management

    a. Areas owners and approvers can view, add, and remove roles from areas.

    b. Managers can assign management to one or more area owners.

    c. Area owners and approvers can delegate their tasks to someone else in the organization while they are away on leave (Example: vacation leave, sick leave, etc.). The delegate will have the same set of permissions as the delegator and can manage the tasks on their behalf.

2. Access Control

a. Area owners and approvers can view, add, and remove people from areas.

b. Area owners and approvers can grant temporary access to roles.

c. Employee supervisor can be required to approve employee access request.

d. Approvers can process access requests using the ClearID web portal.

e. Employee supervisors can delegate their tasks to someone else in the organization while they are away on leave. The delegate will have the same set of permissions as the delegator and can manage the tasks on their behalf.

3. User Permissions

a. Area owners, approvers, and supervisors can approve or deny access requests.

b. Permanent cardholders can request temporary access to areas.

c. Permanent cardholders can invite visitors.

C. Role management

1. Role Management

a. Assign the management roles or cardholder group to one or more role owner.

b. Role managers can add or remove people from their groups.

c. Role owners can assign access to an area for their entire group.

d. Automatic provisioning and synchronization of cardholder groups for multiple sites.

e. Role managers and owners can manage roles in their domain using the ClearID web portal.

f. Role managers and owner can delegate their tasks to someone else in the organization while they are away on leave. The delegate will have the same set of permissions as the delegator and can manage the tasks on their behalf.

2. Role-based provisioning

a. Access can be granted or revoked based on employees' locations.

b. Access can be granted or revoked based on specific roles or job titles in the organization, or who they report to.

c. Access can be granted or revoked based on completion of specific training or possession of required certificates.

d. Access can be granted or revoked based on a list of custom attributes synchronized from an external source.

e. A grace period can be configured to delay the revocation of access by a configurable time period following a change in attributes.

D. Site Management

1. Site Management

a. Global management of cardholders for multiple Synergis™ systems.

b. Time zone support (built-in).

c. Site owners can delegate their tasks to someone else in the organization while they are away on leave. The delegate will have the same set of permissions as the delegator and can manage the tasks on their behalf.

2. Access Control

a. Automatic synchronization of permanent credentials when someone travels between sites.

b. Synchronization of cardholders only happens when cardholders are changed, if cardholder has access on that Synergis™ system.

c. Synchronization of cardholder groups only happens when cardholder groups are changed, if the cardholder group has access on that Synergis™ system.

E. Visitor Management

1. Visitor Management

a. Manual or CSV import pre-registration of visitors using the web portal.

b. Visitor approval workflow can be customized based on the area selected.

c. Visit event approval workflow options can be customized at the site level.

d. Visit event approvers can be assigned to approve a visit event.

e. Visit event approvers can delegate their tasks to someone else in the organization while they are away on leave. The delegate will have the same set of permissions as the delegator and can manage the tasks on their behalf.

f. Automatic provisioning of visitors with the required areas automatically assigned.

g. Visitor check-in using Security Desk.

h. System shall support the configuration of self-service kiosks for visitor check-in.
   1) Kiosk shall be based on iPad hardware.
   2) Tabletop and floor stand kiosk options can be available.
   3) Kiosk supports visitor pre-registration and on-the-spot registration.
   4) Kiosk supports English, French, Spanish, Dutch, German, Italian, and Portuguese languages.

5) Visitors shall be able to check in with a government ID (over 200 supported IDs) or with an email address.
6) Refer to ClearID documentation for supported country IDs.
7) QR code data can be sent to visitors in a Visitor Confirmation email prior to the visit. Kiosk shall have the ability to process the QR code data for the purpose of visitor check-in.
8) Kiosk shall have the ability to print temporary visitor badge with QR code credentials.
9) An SMS alert can be sent to the host when a visitor completes their check in.
10) Kiosk supports Brother QL-820NWB thermal printer.

i. Email notifications when visit request is created.

j. Email notifications when visit request is approved or denied.

k. Capture and report the visit reason.

l. Email invitation sent to visitor with a meeting invite (iCalendar format – RFC 2445), site details, and optional QR code for file attachments.

m. SMS notifications and email sent to visitor host when visitor checks in.

n. Refer to ClearID documentation for supported country codes.

2. Access Control

a. Paper badges and temporary credentials for visitor management.

b. 40-bit QR code sent to visitors can be utilized as a credential in Security Center.

c. Access to specific areas can be restricted on a per-credential basis.

d. Visitor escort can be required, with up to 10 unique visitor hosts.

e. Approvers can process visitor access requests using the ClearID web portal.

3. Platform Management

a. Corporate logo for portal and email notifications

b. Cloud platform

c. HTML5 web interface with mobile support

d. REST API available to automate any functions available in the web portal

4. Security/Authentication Management

a. Support multi-factor authentications for users using OpenID to connect

b. Single Sign-On using Microsoft Office 365

c. Single Sign-On using Microsoft Azure Active Directory (AD)

d. ISO 27001:2013 certification

e. AES-256 encryption with RSA 2048 bits

f. System undergoes annual penetration testing by external accredited security firm

2.49 CARD READERS

A. HID Card reader

1. HID® iCLASS SE® R40

2. Bluetooth

B. HID iClass Reader with Keypad

1. HID® iCLASS SE® RK40

2. Bluetooth

2.50 MISC DOOR HARDWARE

A. PIR RTE

1. Bosch 150i

2. Approved Equal

B. EXIT Hardware

1. SDC S6000 Series Electrified Exit Devices

2. Von Durprin 33 Series Exist Devices

3. Approved Equal

C. POWER TRANSFER DEVICES

1. SDC PTM Concealed Power Transfer Device

2. Approved Equal

D. EXIT BUTTON

1. SDC 420 Series Illuminated Exit Button

2. Approved Equal

2.51 DOOR LOCK POWER SUPPLIES:

A. The Contractor shall provide a dual power supply for each DGP. Each power supply shall provide 24 VDC power to all electric locks and 12DC for DGP power. Each door's electric lock circuit shall be fused independently at the power supply enclosure (on DIN Rail terminal). Shorting or a single door lock circuit shall not affect other doors connected to a common door lock power supply. One (1) power supply shall be provided for each DGP. The door power supply shall include rechargeable standby power to provide a minimum of eight (8) hours of stand-by battery power at peak usage for door locks and DGP 12VDC. The power supplies shall be connected to the dedicated power circuit. The contractor shall provide separate low battery and AC power fail for the DGP and door power supplies.

1. All locks shall be fail secure. All door lock hardware shall provide for free egress from the protected area by activating the door handle or push bar. Door locks and hardware are provided by Division 8, with connection to this hardware by Security Contractor (Division 280500).

2. The power supplies shall meet the requirements of the data gathering panel manufacturer. All data gathering panels shall be supplied with rechargeable batteries. The rechargeable batteries shall be sized to provide a minimum of eight (8) hours of standby power for each power supply within the cabinet. Refer to Power Supply Specification.

2.52 SYSTEM SENSORS AND RELATED EQUIPMENT

A. The ACS (Access Control System) and related Equipment provided by the Contractor shall meet or exceed the following performer specifications:

B. Power Supplies

1. Alarm Device Power Supply & Distribution Cabinet with 12 VDC 10 Ampere Continuous Output Power Supply requirements are as follows:

a. The Security Contractor shall furnish and install power supply and distribution panels. Cabinet shall have a minimum of one (1) 12 VDC power supply for powering the intrusion detection and security system auxiliary devices. Power supplies shall not be loaded beyond 80 percent of the continuous output rating of the power supply. Additional power supplies shall be added to the cabinet to accommodate expanded load demands. Interior of the cabinet shall be arranged to accommodate at least one (1) power supply expansion. Each power supply shall supply 12 VDC (or 24 VDC switch selectable) and a minimum of 10 amperes continuous supply current. Power supply features shall include; filtered and electronically regulated output, built in charger for sealed gel type batteries, automatic switch-over to standby power, thermal and short circuit protection with auto reset, fused battery protection, AC input and DC output LED indicators, and AC power and low battery supervision relays (Form "C", SPDT). Each 12 VDC power supply shall be supplied with one (1) 12 VDC 17 AH rechargeable battery for standby power operation.

b. DIN rail mounted terminal strips shall be provided for all interconnections. DIN rail mounted terminal strips shall have screw-cage clamp type terminals. The use of spring tension terminal strips is prohibited. Ferrules shall be utilized, as needed, to protect individual strands on stranded wire terminations. All ferrule crimping shall be accomplished using a calibrated crimping tool approved by the manufacturer. Alarm input terminals shall be double feed through type. Each cabinet shall be

constructed to provide terminals for a minimum of 50 pairs (50 alarm-input zones). Additional input terminals shall be provided by the Contractor for each zone in expanded applications. (Provide a minimum of 20 percent expansion on the alarm-input terminals.)

c. The branch power circuit supplying detection or auxiliary device power shall have an individual fuse (1.5 AMP. maximum) for each positive leg between the main power supply output and individual distribution circuit. This shall be accomplished by providing DIN rail mounted fuse holders with LED indicators for each power leg. Each distribution cabinet shall be assembled with a minimum of 10 fuse holders with LED indicators for the positive leg and 10 feed-through terminals for the negative leg. The Contractor shall provide additional terminals and fuse blocks for expanded applications. (Provide a minimum of 20 percent expansion on the fuse holder and power terminals.)

d. Each DIN rail terminal strip shall be constructed with grounding blocks at each end of the terminal strips. Grounding blocks shall be utilized to terminate shield drain wires on shielded cables. Excess shield shall be trimmed back to the cable jacket. Each cabinet shall have a minimum of 11 grounding blocks distributed as indicated on the cabinet drawing.

e. Each terminal strip is to be clearly labeled for the intended purpose or function. The terminal strip description shall include system input zone numbers, power polarity, fuse ratings, and device descriptions to facilitate rapid service of the system. The labeling of each terminal or set of terminals shall relate to the corresponding system alarm zones. The Contractor shall provide security system site drawing, DGP assignment sheet, and schematic diagrams in a loose-leaf binder in the document holder on the cabinet door.

f. All transformers and power supplies within the cabinet shall be labeled with permanent labels for their intended purpose and input and output voltage. The AC power cords shall be routed separately from input and low voltage wiring. AC ground shall have continuity to both the mounting panel and the housing. If necessary, the Contractor shall provide grounding straps from the mounting board to the housing.

g. The Contractor shall install a power outlet in the lower left corner of the cabinet. The power outlet shall include a duplex outlet and an on/off switch with red power on indicator light. In expanded applications, the number of outlets shall be increased to support the number of power supply transformers. The power outlet shall be on an individual circuit breaker labeled “security outlets”. If emergency generator circuits are present, the outlets shall be powered from the emergency generator panel.

h. The housing for the power supply and distribution cabinet shall be a side vented NEMA 1 rated enclosure measuring a minimum of 610 x 610 x 204 mm (24 x 24 x 8 in) with a hinged door. (The Contractor shall be responsible for identifying and increasing the cabinet size to accommodate additional power supplies and batteries in expanded applications.) The hinged cabinet door shall have a metal document holder approximately 228 x 279 x 25 mm (9 x 11 x 1 in) integral to the interior of the door. The housing shall be baked gray enamel finish with an inner equipment-mounting panel. All wiring within the cabinet shall be secured by spiral wrap tubing and nylon wire ties with mechanical fasteners (i.e.: screws, rivets, etc.). All wiring shall be neatly routed in horizontal and vertical channels parallel to the cabinet’s sides and the interior terminal strips. Wiring shall not be routed over circuit boards, transformers, or terminal strips. The exterior of the housing shall have no sharp protrusions such as exposed sheet metal screws tips. Power supply circuit boards, open frame transformers, and terminal strips shall be fastened utilizing mechanical fasteners. Appropriately sized circuit board standoffs shall be utilized to prevent shorting of power supply circuit boards to the mounting board. All circuit

board mounting holes shall include standoffs. The mounting screws for permanently attached devices shall be treated with a thread-locking compound. The use of self-adhesive fasteners inside the cabinet is specifically prohibited. The cabinet shall have both front and rear tamper switches connected to the associated DGP tamper circuit. The cabinet shall be equipped with a cam type lock keyed the same as the DGP. To eliminate any false alarms caused by loose fitting doors, the cam lock shall provide sufficient latch pressure and the tamper switch shall be adjusted accordingly.

i. Tamper and power supervisory outputs shall be connected to the unsupervised inputs on the associated DGP. The following conditions shall be annunciated on the SMS: cabinet tamper, AC power failure, and low battery.

j. The Contractor shall assemble cabinets based upon the contract drawing cabinet design for alarm power and distribution power supply cabinets.

k. Acceptable Product(s):

1) Hoffman Enclosures Cabinets or approved equal
2) Securitron Power Supply or approved equal
3) Altech DIN Rail Mounted Terminal Blocks or approved equal

2. DGP/Card Reader/Lock Power Supply & Communications Distribution Panel for Data Gathering Panels and Card Readers shall contain the following specifications (custom built by the contractor):

a. The security Contractor shall provide combination DGP/Card Reader/Lock Power Supply and Communications Distribution Panels. Each panel shall have a minimum of two (2) separate power supplies for powering the DGP, card readers, reader personality modules (RM) and auxiliary devices and locks associated with the DGP. One of the power supplies shall be dedicated exclusively to 12 VDC service and serve as the DGP, card reader, reader module, and auxiliary device (request to exit motion detectors and local sounders) power supply. The second power supply shall provide 24 VDC power for electric locking devices. (Where lock load necessitates a third 24 VDC power supply, the Contractor shall include the third 24 VDC power supply and increase the cabinet proportionately.) Power supplies shall not be loaded beyond eighty percent (80%) of the continuous output rating of the power supply. Each power supply shall supply 12 VDC or 24 VDC (switch selectable) and a minimum 10 Amps continuous supply current. Power supply features shall include; filtered and electronically regulated output, built in charger for sealed gel type batteries, automatic switch-over to standby power, thermal and short circuit protection with auto reset, fused battery protection, AC input and DC output LED indicators, and AC power and low battery supervision relays (Form "C", SPDT).

b. Each 12 VDC power supply shall be supplied with a minimum of one (1) 12 VDC 17 AH rechargeable battery for DGP /Card Reader standby power operation. Each 24 VDC power supply shall be supplied with a minimum of two (2) 12 VDC seven (7) AH rechargeable batteries for lock standby power operation. If necessary, additional batteries shall be supplied by the Contractor to meet the standby time specified elsewhere in the security specification.

c. DIN rail mounted terminal strips shall be provided for all interconnections. DIN rail mounted terminal strips shall have screw-cage clamp type terminals. The use of spring tension terminal strips is prohibited. Ferrules shall be utilized, as needed, to protect individual strands on stranded wire terminations. All ferrule crimping shall be accomplished using a calibrated crimping tool approved by the ferrule manufacturer. The power circuits supplying lock power shall have an individual fuse for each positive leg between the main power supply output and individual distribution circuit. DIN rail mounted fuse holders with LED indicators shall be

provided for each power leg. Each terminal strip is to be clearly labeled for intended purpose. The terminal strip groups shall be permanently labeled to indicate function. The terminal groups would typically include: Lock Relays, Reader Data Lines; Reader/RM/AUX Power. The labeling of each terminal or set of terminals shall relate to the corresponding DGP card reader door. Terminals shall be supplied for a minimum of eight (8) door positions. The Contractor shall provide security system site drawing, data gathering panel assignment sheet and schematic diagrams in a loose-leaf binder in the document holder on the cabinet door.

d. All transformers and power supplies within the cabinet shall be labeled with permanent labels for their intended purpose and input and output voltage. The AC power cords shall be routed separately from input and low voltage wiring. AC ground shall have continuity to both the mounting panel and the housing. If necessary, the Contractor shall provide grounding straps from the mounting board to the housing.

e. The Contractor shall install a power outlet in the lower left corner of the cabinet. The power outlet shall include a duplex outlet and an on/off switch with red power on indicator light. In expanded applications, the number of outlets shall be increased to support the number of power supply transformers. The power outlet shall be on an individual circuit breaker labeled security outlets. If emergency generator circuits are present, the outlets shall be powered from the emergency generator panel.

f. The housing for the cabinet shall be a side vented NEMA 1 rated enclosure measuring a minimum of 610 mm H x 610 mm W x204 mm D (24 x 24 x 8 in) with hinged door. The Contractor shall be responsible for identifying and increasing the cabinet size to accommodate variances in battery sizes, additional power supplies and batteries in expanded applications. The hinged cabinet door shall have a metal document holder approximately 228 mm W x 279 mm H x 25 mm D (9 x 11 x 1 in) integral to the interior of the door. The housing shall be baked gray enamel finish with an inner equipment-mounting panel. All wiring within the cabinet shall be permanently attached using spiral wrap tubing and nylon wire ties with mechanical (i.e.: screws, rivets) fasteners. Also, wiring shall be neatly routed in horizontal and vertical channels parallel to the cabinet's sides and the interior terminal strips. It shall not be routed over circuit boards, transformers, and terminal strips. The exterior of the housing shall have no sharp protrusions such as exposed sheet metal screws tips. Power supply circuit boards, open frame transformers and terminal strips shall be fastened utilizing mechanical fasteners. Circuit board standoffs shall be utilized to prevent shorting of circuit boards to the mounting board. All circuit board mounting holes shall include standoffs. The mounting screws for permanently attached devices shall be treated with a thread-locking compound. The use of self-adhesive fasteners inside the cabinet is specifically prohibited. The cabinet shall have both front and rear tamper switches connected to the associated date gathering panel tamper circuit. The cabinet shall be equipped with a cam type lock keyed the same as the DGP. Cam lock shall provide sufficient latch pressure and tamper switch adjusted to eliminate any false alarms caused by loose fitting doors.

g. Tamper and power outputs shall be connected to the unsupervised inputs on the associated DGP. The following conditions shall be annunciated on the security management system: cabinet tamper, AC power fail, and low battery.

h. The Contractor shall assemble cabinets based upon the contract drawing cabinet design for DGP/Readers and Door Lock Power Supply Panel.

i. Acceptable equipment shall be Hoffman Enclosures Cabinets, Securitron Power Supply, and Altech DIN Rail Mounted Terminal Blocks, or approved equivalent.

PART 3 - EXECUTION

3.1 GENERAL

A. The Contractor shall install all system components and appurtenances in accordance with the manufacturers' instructions, ANSI C2, and shall furnish all necessary interconnections, services, and adjustments required for a complete and operable system as specified. Control signals, communications, and data transmission lines grounding shall be installed as necessary to preclude ground loops, noise, and surges from affecting system operation. Equipment, materials, installation, workmanship, inspection, and testing shall be in accordance with manufacturers' recommendations and as modified herein.

B. Consult the manufacturers' installation manuals for all wiring diagrams, schematics, physical equipment sizes, etc., before beginning system installation. Refer to the Riser/Connection diagram for all schematic system installation/termination/wiring data.

C. All equipment shall be attached to walls and ceiling/floor assemblies and shall be held firmly in place (e.g., sensors shall not be supported solely by suspended ceilings). Fasteners and supports shall be adequate to support the required load.

3.2 CURRENT SITE CONDITIONS

A. The Contractor shall visit the site and verify that site conditions are in agreement with the design package. The Contractor shall report all changes to the site or conditions which will affect performance of the system to the Contracting Officer in a report as defined in paragraph Group II Technical Data Package. The Contractor shall not take any corrective action without written permission from the Contracting Officer.

3.3 EXAMINATION

A. Examine pathway elements intended for cables. Check raceways, cable trays, and other elements for compliance with space allocations, installation tolerances, hazards to cable installation, and other conditions affecting installation.

B. Examine roughing-in for LAN and control cable conduit systems to PCs, Controllers, card readers, and other cable-connected devices to verify actual locations of conduit and back boxes before device installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.4 PREPARATION

A. Comply with recommendations in SIA CP-01.

B. Comply with EIA/TIA-606, "Administration Standard for the Telecommunications Infrastructure of Commercial Buildings."

C. Obtain detailed Project planning forms from manufacturer of access-control system; develop custom forms to suit Project. Fill in all data available from Project plans and specifications and

publish as Project planning documents for review and approval. All forms shall be completed in accordance with specified timelines outlines in Group Technical Data Packages in Section 280500.

1. Record setup data for control station and workstations.

2. For each Location, record setup of Controller features and access requirements.

3. Access Lists

4. Propose start and stop times for time zones and holidays, and match up access levels for doors.

5. Set up groups, facility codes, linking, and list inputs and outputs for each Controller.

6. Assign action message names and compose messages.

7. Set up alarms. Establish interlocks between alarms, intruder detection, and video surveillance features.

8. Prepare and install alarm graphic maps.

9. Develop user-defined fields.

10. Develop screen layout formats.

11. Propose setups for guard tours and key control.

12. Discuss badge layout options; design badges.

13. Complete system diagnostics and operation verification.

14. Prepare a specific plan for system testing, startup, and demonstration (see the Testing section for requirements).

15. Develop acceptance test concept and, on approval, develop specifics of the test.

16. Develop cable and asset management system details; input data from construction documents. Include system schematics and Visio Technical Drawings.

17. Develop data gathering panel matrices that conform to Section 280500.

D. In meetings with Contracting Officer, present Project planning documents and review, adjust, and prepare final setup documents. Use final documents to set up system software.

E. All Programming and access lists are submitted, reviewed, and accomplished before any devices are terminated and/or tested.

END OF SECTION

SECTION 28 13 23 - OPTICAL FIBER BACKBONE CABLING FOR ELECTRONIC SECURITY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. 9/125 micrometer single-mode, indoor-outdoor optical fiber cable (OS1).
   2. Optical fiber cable connecting hardware, patch panels, and cross-connects.
   3. Cabling identification products.

1.2 OPTICAL FIBER BACKBONE CABLING DESCRIPTION

A. Optical fiber backbone cabling system shall provide interconnections between communications equipment rooms, main terminal space, and entrance facilities in the telecommunications cabling system structure. Cabling system consists of backbone cables, intermediate and main cross-connects, mechanical terminations, and patch cords or jumpers used for backbone-to-backbone cross-connection.

B. Backbone cabling cross-connects may be located in communications equipment rooms or at entrance facilities. Bridged taps and splitters shall not be used as part of backbone cabling.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Reviewed and stamped by RCDD.

   1. System Labeling Schedules: Electronic copy of labeling schedules, in software and format selected by Owner.
   2. System Labeling Schedules: Electronic copy of labeling schedules that are part of the cabling and asset identification system of the software.
   3. Cabling administration drawings and printouts.
   4. Wiring diagrams to show typical wiring schematics including the following:

      a. Telecommunications rooms plans and elevations.
      b. Telecommunications pathways.
      c. Telecommunications system access points.
      d. Telecommunications grounding system
      e. Cross-connects.
      f. Patch panels.
      g. Patch cords.

   5. Cross-connects and patch panels.

C. Optical fiber cable testing plan.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For [RCDD,] [Installer,]installation supervisor, and field inspector.

B. Source quality-control reports.

C. Field quality-control reports.

D. Product Certificates: For each type of product.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.

1. Layout Responsibility: Preparation of Shop Drawings and Cabling Administration Drawings by an RCDD.
2. Installation Supervision: Installation shall be under the direct supervision of 2 Installer, who shall be present at all times when Work of this Section is performed at Project site.
3. Testing Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.

B. Testing Agency Qualifications: Testing agency must have personnel certified by BICSI on staff.

1. Testing Agency's Field Supervisor: Currently certified by BICSI as an RCDD.

C. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: 25or less.
2. Smoke-Developed Index: 50 or less.

1.7 COORDINATION

A. Coordinate layout and installation of telecommunications pathways and cabling with Owner's telecommunications and LAN equipment and service suppliers.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. General Performance: Backbone cabling system shall comply with transmission standards in TIA-568-C.1, when tested according to test procedures of this standard.

B. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: 25 or less.
2. Smoke-Developed Index: 50 or less.

C. Telecommunications Pathways and Spaces: Comply with TIA-569-D.

D. Grounding: Comply with TIA-607-B.

2.2 9/125 MICROMETER SINGLE-MODE, INDOOR-OUTDOOR OPTICAL FIBER CABLE (OS1)

A. Description: Single mode, 9/125-micrometer, 6 fibers, single loose tube, optical fiber cable.

B. Standards:

1. Comply with TIA-492CAAA for detailed specifications.
2. Comply with TIA-568-C.3 for performance specifications.
3. Comply with ICEA S-104-696 for mechanical properties.

C. Armored cable shall be steel or aluminum armored type.

D. Maximum Attenuation: 0.5 dB/km at 1310 nm; 0.5 dB/km at 1550 nm.

E. Jacket:

1. Jacket Color: Yellow
2. Cable cordage jacket, fiber, unit, and group color shall be according to TIA-598-D.
3. Imprinted with fiber count, fiber type, and aggregate length at regular intervals not to exceed 40 inches (1000 mm).

F. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444, UL 1651, and NFPA 70 for the following types:
1. Plenum Rated, Armored (Conductive): Type OFCP, Type OFNP, Type OFCR, or Type OFNR in metallic conduit installed per NFPA 70, Article 300.22, "Wiring in Ducts, Plenums, and Other Air-Handling Spaces."

2.3 OPTICAL FIBER CABLE HARDWARE

A. Standards:

1. Comply with Optical Fiber Connector Intermateability Standard specifications of the TIA-604 series.
2. Comply with TIA-568-C.3.

B. Cross-Connects and Patch Panels: Modular panels housing multiple-numbered, duplex cable connectors.

1. Number of Connectors per Field: Two for each fiber of cable or cables assigned to field, plus spares and blank positions adequate to suit specified expansion criteria.

C. Patch Cords: Factory-made, dual-fiber cables in 36-inch (900-mm) lengths.

D. Connector Type: Type LC complying with TIA-604-10-B.

E. Plugs and Plug Assemblies:

1. Male; color-coded modular telecommunications connector designed for termination of a single optical fiber cable.
2. Insertion loss not more than 0.25 dB.
3. Marked to indicate transmission performance.

F. Jacks and Jack Assemblies:

1. Female; quick-connect, simplex and duplex; fixed telecommunications connector designed for termination of a single optical fiber cable.
2. Insertion loss not more than 0.25 dB.
3. Marked to indicate transmission performance.
4. Designed to snap-in to a patch panel or faceplate.

2.4 GROUNDING

A. Comply with requirements in Section 270526 "Grounding and Bonding for Communications Systems" for grounding conductors and connectors.

B. Comply with TIA-607-B.

2.5 IDENTIFICATION PRODUCTS

A. Comply with TIA-606-B and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

2.6 SOURCE QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to evaluate cables.

B. Factory test multimode optical fiber cables according to TIA-526-14-B and TIA-568-C.3.

C. Factory test pre-terminated optical fiber cable assemblies according to TIA-526-14-B and TIA-568-C.3.

D. Cable will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 ENTRANCE FACILITIES

A. Coordinate backbone cabling with the protectors and demarcation point provided by communications service provider.

3.2 WIRING METHODS

A. Wiring Method: Install cables in raceways and cable trays except within consoles, cabinets, desks, and counters. Conceal raceway and cables except in unfinished spaces.

1. Install plenum cable in environmental air spaces, including plenum ceilings.
2. Comply with requirements for pathways specified in Section 270528 "Pathways for Communications Systems."

B. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.

C. Wiring within Enclosures: Bundle, lace, and train cables within enclosures. Connect to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.

3.3 INSTALLATION OF OPTICAL FIBER BACKBONE CABLES

A. Comply with NECA 1, NECA 301, and NECA/BICSI 568.

B. General Requirements for Optical Fiber Cabling Installation:

1. Comply with TIA-568-C.1 and TIA-568-C.3.
2. Comply with BICSI ITSIMM, Ch. 6, "Cable Termination Practices."
3. Terminate all cables; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.
4. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches (760 mm) and not more than 6 inches (150 mm) from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
5. Install lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.
6. Bundle, lace, and train cable to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIMM, "Cabling Termination Practices" Chapter. Use lacing bars and distribution spools.
7. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
8. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
9. In the communications equipment room, provide a 10-foot- (3-m-) long service loop on each end of cable.
10. Pulling Cable: Comply with BICSI ITSIMM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.
11. Cable may be terminated on connecting hardware that is rack or cabinet mounted.

C. Open-Cable Installation:

1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
2. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.

D. Installation of Cable Routed Exposed under Raised Floors:

1. Install plenum-rated cable only.
2. Install cabling after the flooring system has been installed in raised floor areas.
3. Coil cable 6 feet (1800 mm) long not less than 12 inches (300 mm) in diameter below each feed point.

E. Group connecting hardware for cables into separate logical fields.

3.4 FIRESTOPPING

A. Comply with requirements in Section 078413 "Penetration Firestopping."

B. Comply with TIA-569-D, Annex A, "Firestopping."

C. Comply with BICSI ITSIMM, "Firestopping" Chapter.

3.5 GROUNDING

A. Install grounding according to BICSI ITSIMM, "Grounding (Earthing), Bonding, and Electrical Protection" Chapter.

B. Comply with TIA-607-B and NECA/BICSI-607.

C. Locate grounding bus bar to minimize the length of bonding conductors. Fasten to wall allowing at least 2-inch (50-mm) clearance behind the grounding bus bar. Connect grounding bus bar with a minimum No. 4 AWG grounding electrode conductor from grounding bus bar to suitable electrical building ground.

D. Bond metallic equipment to the grounding bus bar, using not smaller than No. 6 AWG equipment grounding conductor.

3.6 IDENTIFICATION

A. Identify system components, wiring, and cabling complying with TIA-606-B. Comply with requirements for identification specified in Section 270553 "Identification for Communications Systems."

1. Administration Class: Class 2.
2. Color-code cross-connect fields and apply colors to voice and data service backboards, connections, covers, and labels.

B. Paint and label colors for equipment identification shall comply with TIA-606-B for Class 2 level of administration including optional identification requirements of this standard.

C. Comply with requirements in Section 271523 "Communications Optical Fiber Horizontal Cabling" for cable and asset management software.

D. Cable Schedule: Install in a prominent location in each equipment room and wiring closet. List incoming and outgoing cables and their designations, origins, and destinations. Protect with rigid frame and clear plastic cover. Furnish an electronic copy of final comprehensive schedules for Project.

E. Cabling Administration Drawings: Show building floor plans with cabling administration-point labeling. Identify labeling convention and show labels for telecommunications closets, backbone pathways and cables, terminal hardware and positions, horizontal cables, work areas and workstation terminal positions, grounding buses and pathways, and equipment grounding conductors.

F. Cable and Wire Identification:

1. Label each cable within 4 inches (100 mm) of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.
2. Each wire connected to building-mounted devices is not required to be numbered at device if color of wire is consistent with associated wire connected and numbered within panel or cabinet.
3. Exposed Cables and Cables in Cable Trays and Wire Troughs: Label each cable at intervals not exceeding 15 feet (4.5 m).
4. Label each unit and field within distribution racks and frames.
5. Identification within Connector Fields in Equipment Rooms and Wiring Closets: Label each connector and each discrete unit of cable-terminating and connecting hardware. Where similar jacks and plugs are used for both voice and data communication cabling, use a different color for jacks and plugs of each service.

G. Labels shall be preprinted or computer-printed type with printing area and font color that contrasts with cable jacket color but still complies with requirements in TIA 606-B, for the following:

1. Flexible vinyl or polyester that flexes as cables are bent.

3.7 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Perform tests and inspections.

C. Tests and Inspections:

1. Visually inspect optical fiber jacket materials for NRTL certification markings. Inspect cabling terminations in communications equipment rooms for compliance with color-coding for pin assignments, and inspect cabling connections for compliance with TIA-568-C.1.
2. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
3. Optical Fiber Cable Tests:

a. Test instruments shall meet or exceed applicable requirements in TIA-568-C.1. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
b. Link End-to-End Attenuation Tests:

1) Horizontal and multimode backbone link measurements: Test at 850 or 1300 nm in one direction according to TIA-526-14-B, Method B, One Reference Jumper.
2) Attenuation test results for backbone links shall be less than 2.0 dB. Attenuation test results shall be less than those calculated according to equation in TIA-568-C.1.

D. Data for each measurement shall be documented. Data for submittals shall be printed in a summary report that is formatted similar to Table 10.1 in BICSI TDMM, or transferred from the instrument to the computer, saved as text files, and printed and submitted.

E. Remove and replace cabling where test results indicate that it does not comply with specified requirements.

F. End-to-end cabling will be considered defective if it does not pass tests and inspections.

G. Prepare test and inspection reports.

END OF SECTION

SECTION 28 15 13 – SECURITY COPPER HORIZONTAL CABLING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Category 6A twisted pair cable.
2. Twisted pair cable hardware, including plugs and jacks.
3. Multiuser telecommunications outlet assembly.
4. Cable management system.
5. Cabling identification products.
6. Grounding provisions for twisted pair cable.
7. Source quality control requirements for twisted pair cable.

B. Related Requirements:

1. Section 270513 "Conductors and Cables for Communications Systems" for data cabling associated with system panels and devices.

1.2 DEFINITIONS

A. Cross-Connect: A facility enabling the termination of cable elements and their interconnection or cross-connection.
B. EMI: Electromagnetic interference.
C. FTP: Shielded twisted pair.
D. F/FTP: Overall foil screened cable with foil screened twisted pair.
E. F/UTP: Overall foil screened cable with unscreened twisted pair.
F. IDC: Insulation displacement connector.
G. LAN: Local area network.
H. Jack: Also commonly called an "outlet," it is the fixed, female connector.
I. Plug: Also commonly called a "connector," it is the removable, male telecommunications connector.
J. RCDD: Registered Communications Distribution Designer.
K. Screen: A metallic layer, either a foil or braid, placed around a pair or group of conductors.
L. Shield: A metallic layer, either a foil or braid, placed around a pair or group of conductors.
M. S/FTP: Overall braid screened cable with foil screened twisted pair.
N. S/UTP: Overall braid screened cable with unscreened twisted pairs.
O. UTP: Unscreened (unshielded) twisted pair.

1.3 COPPER HORIZONTAL CABLING DESCRIPTION

A. Horizontal cable cabling system shall provide interconnections between Distributor A, Distributor B, or Distributor C, and the equipment outlet, otherwise known as "Cabling Subsystem 1," in the telecommunications cabling system structure. Cabling system consists of horizontal cables, intermediate and main cross-connects, mechanical terminations, and patch cords or jumpers used for horizontal-to-horizontal cross-connection.

1. TIA-568-C.1 requires that a minimum of two equipment outlets be installed for each work area.
2. Horizontal cabling shall contain no more than one transition point or consolidation point between the horizontal cross-connect and the telecommunications equipment outlet.
3. Bridged taps and splices shall not be installed in the horizontal cabling.

B. A work area is approximately 100 sq. ft. (9.3 sq. m), and includes the components that extend from the equipment outlets to the station equipment.
C. The maximum allowable horizontal cable length is 295 feet (90 m). This maximum allowable length does not include an allowance for the length of 16 feet (4.9 m) to the workstation equipment or in the horizontal cross-connect.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.
B. Shop Drawings: Reviewed and stamped by RCDD.

1. System Labeling Schedules:

a. Electronic copy of labeling schedules, in software and format selected by Owner.
b. Electronic copy of labeling schedules that are part of cabling and asset identification system of software.

2. Cabling administration Drawings and printouts.
3. Wiring diagrams and installation details of telecommunications equipment, to show location and layout of telecommunications equipment, including the following:

a. Telecommunications rooms plans and elevations.
b. Telecommunications pathways.
c. Telecommunications system access points.
d. Telecommunications grounding system.
e. Telecommunications conductor drop locations.
f. Typical telecommunications details.
g. Mechanical, electrical, and plumbing systems.

C. Twisted pair cable testing plan.
D. Samples: For telecommunications jacks and plugs, in specified finish, one for each type and configuration and cover plates for color selection and evaluation of technical features.
E. Field Quality-Control Submittals:

1. Field quality-control reports.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For RCDD, installation supervisor, and field inspector.
B. Product Certificates: For each type of product.
C. Source quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For splices and connectors to include in maintenance manuals.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Connecting Blocks: Two of each type.
2. Cover Plates: Two of each type.
3. Jacks: Twenty of each type.
4. Multiuser Telecommunications Outlet Assemblies: One of each type, when used.
5. Patch-Panel Units: Two of each type.
6. Plugs: Twenty of each type.

1.8 QUALITY ASSURANCE

A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.

1. Layout Responsibility: Preparation of Shop Drawings and cabling administration Drawings, and field testing program development] by an RCDD.
2. Installation Supervision: Installation shall be under the direct supervision of Level 2 Installer, who shall be present at all times when Work of this Section is performed at Project site.
3. Testing Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.

B. Testing Agency Qualifications: Testing agency must have personnel certified by BICSI on staff.

1. Testing Agency's Field Supervisor: Currently certified by BICSI as an RCDD.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Test cables upon receipt at Project site.

1. Test each pair of twisted pair cable for open and short circuits.

1.10 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install cables and connecting materials until wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

1.11 COORDINATION

A. Coordinate layout and installation of telecommunications pathways and cabling with Owner's telecommunications and LAN equipment and service suppliers.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. General Performance: Horizontal cabling system shall comply with transmission standards in TIA-568-C.1, when tested according to test procedures of this standard.
B. Telecommunications Pathways and Spaces: Comply with TIA-569-D.
C. Grounding: Comply with TIA-607-B.

2.2 GENERAL CABLE CHARACTERISTICS

A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with the applicable standard and NFPA 70 for the following types:

1. Communications, Plenum Rated:

a. Type CMP complying with UL 1685 or Type CMP in listed cable routing assembly.
b. Type CM, Type CMG, Type CMP, Type CMR, or Type CMX in metallic conduit installed according to NFPA 70, Article 300.22, "Wiring in Ducts, Plenums, and Other Air-Handling Spaces."

2. Communications, Non-Plenum Rated:

a. Type CMP or Type CMR in metallic conduit installed according to NFPA 70, Article 300.22, "Wiring in Ducts, Plenums, and Other Air-Handling Spaces."

B. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: 25 or less.
2. Smoke-Developed Index: 50 or less.

C. RoHS compliant.

2.3 CATEGORY 6 TWISTED PAIR CABLE

A. Description: Four-pair, balanced-twisted pair cable, with internal spline, certified to meet transmission characteristics of Category 6 cable at frequencies up to 250 MHz.
B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. 3M.
2. AMP NETCONNECT; a TE Connectivity Ltd. company.
3. Belden Inc.
4. Berk-Tek Leviton; a Nexans/Leviton alliance.
5. CommScope, Inc.
6. General Cable; Prysmian Group North America.
7. Genesis Cable Products; Honeywell International, Inc.
8. Hitachi Cable America Inc.
9. Mohawk Cable; brand of Belden, Inc.
10. Prysmian Cables and Systems; Prysmian Group North America.
11. Superior Essex Inc.; subsidiary of LS Corp.

C. Standard: Comply with NEMA WC 66/ICEA S-116-732 and TIA-568-C.2 for Category 6 cables.
D. Conductors: 100-ohm, 23 AWG solid copper.
E. Shielding/Screening: Unshielded twisted pairs (UTP).
F. Cable Rating: Plenum.
G. Jacket: See plans for requirements.

2.4 TWISTED PAIR CABLE HARDWARE

A. Description: Hardware designed to connect, splice, and terminate twisted pair copper communications cable.
B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. 3M.
2. American Technology Systems Industries, Inc.
3. AMP NETCONNECT; a TE Connectivity Ltd. company.
4. Belden Inc.
5. Berk-Tek Leviton; a Nexans/Leviton alliance.
6. CommScope, Inc.
7. Dynacom Corporation.
8. General Cable; Prysmian Group North America.
9. Genesis Cable Products; Honeywell International, Inc.
10. Hubbell Premise Wiring; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
11. KRONE Incorporated.
12. Leviton Manufacturing Co., Inc.
13. Mohawk Cable; brand of Belden, Inc.
14. Molex Connected Enterprise Solutions; business of Molex, LLC; Koch Industries.
15. Panduit Corp.

16. Prysmian Cables and Systems; Prysmian Group North America.
17. Siemon Co. (The).
18. Superior Essex Inc.; subsidiary of LS Corp.

C. General Requirements for Twisted Pair Cable Hardware:

1. Comply with the performance requirements of Category 6.
2. Comply with TIA-568-C.2, IDC type, with modules designed for punch-down caps or tools.
3. Cables shall be terminated with connecting hardware of same category or higher.

D. Source Limitations: Obtain twisted pair cable hardware from same manufacturer as twisted pair cable, from single source.

E. Connecting Blocks:

1. 110-style IDC for Category 5e.
2. 66-style IDC for Category 5e.
3. 110-style IDC for Category 6.
4. 110-style IDC for Category 6a.
5. Provide blocks for the number of cables terminated on the block, plus 25 percent spare, integral with connector bodies, including plugs and jacks where indicated.
6. Number of Terminals per Field: One for each conductor in assigned cables.

F. Patch Panel: Modular panels housing numbered jack units with IDC-type connectors at each jack location for permanent termination of pair groups of installed cables.

1. Features:

a. Universal T568A and T568B wiring labels.
b. Labeling areas adjacent to conductors.
c. Replaceable connectors.
d. 24 or 48 ports.

2. Construction: 16-gauge steel and mountable on 19-inch (483 mm) equipment racks.
3. Number of Jacks per Field: One for each four-pair cable indicated]

G. Patch Cords: Factory-made, four-pair cables in 36-inch lengths; terminated with an eight-position modular plug at each end.

1. Patch cords shall have bend-relief-compliant boots and color-coded icons to ensure performance. Patch cords shall have latch guards to protect against snagging.

H. Plugs and Plug Assemblies:

1. Male; eight position; color-coded modular telecommunications connector designed for termination of a single four-pair, 100-ohm, unshielded or shielded twisted pair cable.
2. Standard: Comply with TIA-568-C.2.

I. Jacks and Jack Assemblies:

1. Female; eight position; modular; fixed telecommunications connector designed for termination of a single four-pair, 100-ohm, unshielded or shielded twisted pair cable.
2. Designed to snap-in to a patch panel or cover plate.
3. Standard: Comply with TIA-568-C.2.

J. Cover Plate:

1. Six port, vertical single gang cover plates designed to mount to double gang wall boxes with single gang mud ring.
2. Twelve port, vertical double gang cover plates designed to mount to double gang wall boxes. Where indicated on plans.
3. Metal Cover Plate: Stainless steel, complying with requirements in Section 260533 "Raceway and Boxes for Electrical Systems."
4. For use with snap-in jacks accommodating any combination of twisted pair, optical fiber, and coaxial work area cords.

    a. Flush mounting jacks, positioning the cord at a 45-degree angle.

K. Legend:

1. Machine printed, in the field, using adhesive-tape label.
2. Snap-in, clear-label covers and machine-printed paper inserts.

2.5 CABLE MANAGEMENT SYSTEM

A. Description: Computer-based cable management system, with integrated database and graphic capabilities.
B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. iTRACS Corporation.
2. Telsoft Solutions.

C. Information shall be presented in database view, schematic plans, or technical drawings.

1. AutoCAD drawing software shall be used as drawing and schematic plans software.

D. System shall interface with the following testing and recording devices:

1. Direct upload tests from circuit testing instrument into the personal computer.
2. Direct download circuit labeling into labeling printer.

2.6 IDENTIFICATION PRODUCTS

A. Comply with TIA-606-B and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

2.7 SOURCE QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to evaluate cables.
B. Factory test cables on reels according to TIA-568-C.1.
C. Factory test twisted pair cables according to TIA-568-C.2.
D. Cable will be considered defective if it does not pass tests and inspections.
E. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 WIRING METHODS

A. Routing:

1. Install cables in raceways and cable trays, except within consoles, cabinets, desks, and counters and except in accessible ceiling spaces, attics, and gypsum board partitions

where unenclosed wiring method may be used. Conceal raceway and cables, except in unfinished spaces.

a. Install plenum cable in environmental air spaces, including plenum ceilings.
b. Comply with requirements for raceways and boxes specified in Section 270528 "Pathways for Communications Systems."

2. Conceal conductors and cables in accessible ceilings, walls, and floors where possible.

3.2 INSTALLATION OF PATHWAYS

A. Comply with requirements for demarcation point, cabinets, and racks specified in Section 271100 "Communications Equipment Room Fittings."
B. Comply with Section 270528 "Pathways for Communications Systems."
C. Comply with Section 270529 "Hangers and Supports for Communications Systems."
D. Comply with Section 270536 "Cable Trays for Communications Systems."
E. Drawings indicate general arrangement of pathways and fittings.

3.3 INSTALLATION OF TWISTED-PAIR HORIZONTAL CABLES

A. Comply with NECA 1 and NECA/BICSI 568.
B. General Requirements for Cabling:

1. Comply with TIA-568-C.0, TIA-568-C.1, and TIA-568-C.2.
2. Comply with BICSI's "Information Transport Systems Installation Methods Manual (ITSIMM), Ch. 5, "Copper Structured Cabling Systems," "Cable Termination Practices" Section.
3. Install 110-style IDC termination hardware unless otherwise indicated.
4. Do not untwist twisted pair cables more than 1/2 inch (12 mm) from the point of termination to maintain cable geometry.
5. Terminate all conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.
6. MUTOA shall not be used as a cross-connect point.
7. Consolidation points may be used only for making a direct connection to equipment outlets:

a. Do not use consolidation point as a cross-connect point, as a patch connection, or for direct connection to workstation equipment.
b. Locate consolidation points for twisted-pair cables at least 49 feet (15 m) from communications equipment room.

8. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches (760 mm) and not more than 6 inches (150 mm) from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
9. Install lacing bars to restrain cables, prevent straining connections, and prevent bending cables to smaller radii than minimums recommended by manufacturer.
10. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI Information Transport Systems Installation Methods Manual, Ch. 5, "Copper Structured Cabling Systems," "Cable Termination Practices" Section. Use lacing bars and distribution spools.
11. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation, and replace it with new cable.
12. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
13. In the communications equipment room, install a 10-foot- (3-m-) long service loop on each end of cable.

14. Pulling Cable: Comply with BICSI Information Transport Systems Installation Methods Manual, Ch. 5, "Copper Structured Cabling Systems," "Pulling and Installing Cable" Section. Monitor cable pull tensions.

C. Open-Cable Installation:

1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
2. Suspend twisted pair cabling, not in a wireway or pathway, a minimum of 12 inches above ceilings by cable supports not more than 48 inches apart.
3. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.

D. Installation of Cable Routed Exposed under Raised Floors:

1. Install plenum-rated cable only.
2. Install cabling after the flooring system has been installed in raised floor areas.
3. Coil cable 6 feet long not less than 12 inches in diameter below each feed point.

E. Group connecting hardware for cables into separate logical fields.
F. Separation from EMI Sources:

1. Comply with recommendations from BICSI's "Telecommunications Distribution Methods Manual" and TIA-569-D for separating unshielded copper communication cable from potential EMI sources, including electrical power lines and equipment.
2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:

    a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches (127 mm).
    b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches (300 mm).
    c. Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches (600 mm).

3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:

    a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches (64 mm).
    b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches (150 mm).
    c. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches (300 mm).

4. Separation between communications cables in grounded metallic raceways, power lines, and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:

    a. Electrical Equipment Rating Less Than 2 kVA: No requirement.
    b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches (76 mm).
    c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches (150 mm).

5. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches (1200 mm).
6. Separation between Communications Cables and Fluorescent Fixtures: A minimum of 5 inches (127 mm).

3.4 FIRESTOPPING

A. Comply with requirements in Section 078413 "Penetration Firestopping."
B. Comply with TIA-569-D, Annex A, "Firestopping."
C. Comply with "Firestopping Systems" Article in BISCI's "Telecommunications Distribution Methods Manual."

3.5 GROUNDING

A. Comply with requirements in Section 270526 "Grounding and Bonding for Communications Systems" for grounding conductors and connectors.
B. Install grounding according to the "Grounding, Bonding, and Electrical Protection" chapter in BICSI's "Telecommunications Distribution Methods Manual."
C. Comply with TIA-607-B and NECA/BICSI-607.
D. Locate grounding bus bar to minimize the length of bonding conductors. Fasten to wall, allowing at least a 2-inch (50-mm) clearance behind the grounding bus bar. Connect grounding bus bar to suitable electrical building ground, using a minimum No. 4 AWG grounding electrode conductor.
E. Bond metallic equipment to the grounding bus bar, using not smaller than a No. 6 AWG equipment grounding conductor.

3.6 IDENTIFICATION

A. Identify system components, wiring, and cabling complying with TIA-606-B. Comply with requirements for identification specified in Section 270553 "Identification for Communications Systems."

    1. Administration Class: Class 3.
    2. Color-code cross-connect fields and apply colors to voice and data service backboards, connections, covers, and labels.

B. Paint and label colors for equipment identification shall comply with TIA-606-B for Class 3 level of administration, including optional identification requirements of this standard.
C. Cable Schedule: Install in a prominent location in each equipment room and wiring closet. List incoming and outgoing cables and their designations, origins, and destinations. Protect with rigid frame and clear plastic cover. Furnish an electronic copy of final comprehensive schedules for Project.
D. Cabling Administration Drawings: Show building floor plans with cabling administration-point labeling. Identify labeling convention and show labels for telecommunications closets, terminal hardware and positions, horizontal cables, work areas and workstation terminal positions, grounding buses and pathways, and equipment grounding conductors.
E. Cable and Wire Identification:

    1. Label each cable within 4 inches (100 mm) of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.
    2. Each wire connected to building-mounted devices is not required to be numbered at the device if wire color is consistent with associated wire connected and numbered within panel or cabinet.
    3. Exposed Cables and Cables in Cable Trays and Wire Troughs: Label each cable at intervals not exceeding 15 feet (4.5 m).
    4. Label each terminal strip, and screw terminal in each cabinet, rack, or panel.

        a. Individually number wiring conductors connected to terminal strips, and identify each cable or wiring group, extended from a panel or cabinet to a building-mounted device, with the name and number of a particular device.
        b. Label each unit and field within distribution racks and frames.

5. Identification within Connector Fields in Equipment Rooms and Wiring Closets: Label each connector and each discrete unit of cable-terminating and -connecting hardware. Where similar jacks and plugs are used for both voice and data communication cabling, use a different color for jacks and plugs of each service.

F. Labels shall be preprinted or computer-printed type, with a printing area and font color that contrast with cable jacket color but still comply with TIA-606-B requirements for the following:

1. Cables use flexible vinyl or polyester that flexes as cables are bent.

3.7 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Visually inspect jacket materials for NRTL certification markings. Inspect cabling terminations in communications equipment rooms for compliance with color-coding for pin assignments and inspect cabling connections for compliance with TIA-568-C.1.
2. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
3. Test twisted pair cabling for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination but not cross-connection.

a. Test instruments shall meet or exceed applicable requirements in TIA-568-C.2. Perform tests with a tester that complies with performance requirements in "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.

B. Data for each measurement shall be documented. Data for submittals shall be printed in a summary report that is formatted similarly to Table 10.1 in BICSI's "Telecommunications Distribution Methods Manual," or shall be transferred from the instrument to the computer, saved as text files, printed, and submitted.
C. Nonconforming Work:

1. End-to-end cabling will be considered defective if it does not pass tests and inspections.
2. Remove and replace cabling where test results indicate that they do not comply with specified requirements.

D. Collect, assemble, and submit test and inspection reports.
E. Manufacturer Services:

1. Engage factory-authorized service representative to support field tests and inspections.

END OF SECTION

SECTION 28 15 23 - INTERCOM AND PUBLIC ADDRESS SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Digital audio intercom entry systems.
2. Digital audio-video intercom entry systems.

B. Related Requirements:

1. Section 260011 "Facility Performance Requirements for Electrical" for seismic-load, wind-load, acoustical, and other field conditions applicable to Work specified in this Section.
2. Section 280010 "Supplemental Requirements for Electronic Safety and Security" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Coordination Meeting(s): For intercom entry system. Conduct meeting(s) at Project site before construction activity.

1. Attendees: Installers, fabricators, representatives of manufacturers, representatives from telecommunications, Owner's security representatives, IT representatives, and administrants for field tests and inspections. Notify Architect, Construction Manager, and Owner's Commissioning Authority of scheduled meeting dates.

1.3 ACTION SUBMITTALS

A. Product Data:

1. Digital audio intercom entry systems.
2. Digital audio-video intercom entry systems.
3. PA system speakers

B. Shop Drawings:

1. Project general notes.
2. Device layout.
3. Block diagram and cable/conduit routing.
4. System communications details.
5. System mounting details.
6. Secondary power calculations.

C. Field Quality-Control Submittals:

1. Field quality-control reports.

1.4 INFORMATIONAL SUBMITTALS

A. Manufacturers' Published Instructions: Record copy of official installation and testing instructions issued to Installer by manufacturer for the following:

1. Installation and startup instructions for intercom entry systems.

2. Manufacturer's recommended tests and inspections for intercom entry systems.

B. Sample warranties.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Contracts:

1. Software and firmware service agreement.

B. Warranty documentation.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Special Tools: Furnish to Owner proprietary equipment, keys, and software required to operate, maintain, repair, adjust, or implement future changes to intercom entry system, that are packaged with protective covering for storage on-site and identified with labels describing contents.

1.7 WARRANTY

A. Special Installer Extended Warranty: Installer warrants that fabricated and installed intercom entry system perform in accordance with specified requirements and agrees to repair or replace components or products that fail to perform as specified within extended-warranty period.

1. Extended-Warranty Period: **Three** years from date from system acceptance; full coverage for labor, materials, and equipment.

B. Special Manufacturer Extended Warranty: Manufacturer warrants that intercom entry system perform in accordance with specified requirements and agrees to provide repair or replacement of components or products that fail to perform as specified within extended-warranty period.

1. Warranty Period: **Three** years from date of acceptance; **full** coverage for labor, materials, and equipment.

PART 2 - PRODUCTS

2.1 DIGITAL AUDIO INTERCOM ENTRY SYSTEMS

A. Manufacturers

1. Acceptable Manufacturer:

a. Zenitel Intercom Master and PA Speakers
b. Approved Equal

2. Requests for substitutions will be considered in accordance with provisions of Section 28 05 00.

B. Performance and Design Requirements

1. Standards Compliance:

a. Supports the following SIP protocols:

1) RFC 3261.

2) RFC 3215.
3) RFC 2976.
4) RFC 2833.
5) RFC 4566.
6) RFC 3550.

b. Supports open IP standards, including:

1) SIP.
2) HTTP(s).
3) NTP.
4) SNMP.
5) SSH.
6) SIPS.
7) DIP.
8) mDNS.
9) Discovery.
10) VoIP.
11) Multicast

c. Audio codecs shall be:

1) G.722 (HD Voice).
2) G.711A.
3) G.711u.
4) G.729 for SIP phones.

2. System shall provide fast open duplex voice communication with emergency paging and active noise cancellation for high noise environments.
3. System shall assist with personnel safety, facility security, operational efficiency, critical communication, visitor entry and maintenance functions.
4. Capable of full and open duplex, hands-free operation, without the use of handsets, at both the initiating and receiving station.
5. Stations shall connect to a SIP based IP PBX platform in an appropriate secure data processing room.
6. Built-in firewall allows opening or closing of each protocol as user wishes.
7. Web browser-based configuration.
8. May be programmed on site with a standard PC.
9. Stations shall have adaptive jitter buffering.
10. Capable of adding optional features, equipment, and interfaces, even if not initially included.

2.2 IP TOUCH SCREEN DESK MASTER

A. Desk master station equipped with full keypad and touchscreen video display. Uses Android based OS system user interface that is very intuitive, familiar, and easy to use. Station supports H.264 HD or MJPEG video, G.722 & G.729 audio codecs. Capable of Video Conference with other ITSV-2's, Call Forwarding, Call Queuing and Multicast. Provides wired LAN connection to network as well as Bluetooth capability for wireless headset along with WIFI connectivity if needed. DAK key shortcuts can be stored on the touchscreen for quick dialing of stations or features. Connection is to a PoE switch or power injector. Shall be ITSV-2 #1490002010.

1490002010

2.3 IP VIDEO STATION

A. Security Gate and Building Entrances

1. 2N IP Force video intercom with card reader space, Model: 01334-001
2. Zenitel TEIV-4+ Video Intercom with card reader space, Model: **1008318240**

B. Interior Locations

1. 2N IP Base video intercom, Model: 01357-001
2. Zenitel TEIV-4+ Video Intercom with card reader space, Model: **1008318240**

C. Accessories 2N

1. Brick Flush Mounting BoxOrder No.: 01348-001
2. Gooseneck StandOrder No.: 01351-001
3. Installation AdapterOrder No.: 01352-001
4. Mounting
    a. Brick Flush Mounting Box, Model: 01348-001
    b. Plasterboard Flush Mounting Box, Model: 01349-001
    c. Security Screws, Model: 01345-001
    d. Backplate, Model: 01360-001
5. Other Accessories:
    a. External IP Relay - 1 Output, 1 Input, Model: 01397-001
    b. External RFID Card Reader 125kHz + 13.56MHz with NFC (USB), Model: 01400-001

D. Accessories Zenitel

1. Turbine Extended Flushmount Backbox, Model: TA-34
2. Turbine Extended On-wall Backbox, Model: TA-33 (Back of House locations only)

2.4 AREA OF REFUGE

A. Zenitel TCIS-C1, IP and SIP Intercom, Model: 1008111901

B. Accessories

1. Bracket for US 2 GANG Double Depth Back Box, TA-5

2.5 IP SPEAKERS

A. PA IP CEILING SPEAKER. This IP ceiling speaker shall be individually addressable and ideal for applications that only require a limited number of speakers. PoE capable and provides 10 watts of output power. Remote software upgrade & configuration is done via built in web server. Shall be IP Ceiling Speaker ELSIR-10C #1023300010.

1023300010

B. PA IP HORN SPEAKER. This IP horn loudspeaker shall be individually addressable and ideal for applications that only require a limited number of speakers. PoE capable and provides 10 watts of output power. Remote software upgrade, configuration is done via built in web server. Shall be IP Horn Speaker ELSII-10H #1023301310.

1023301310

PART 3 - EXECUTION

3.1 EXAMINATION

A. Do not begin installation until substrates have been properly constructed and prepared.
B. If substrate preparation is the responsibility of another installer, notify Architect in writing of unsatisfactory preparation before proceeding.

3.2 PREPARATION

A. Clean surfaces thoroughly prior to installation.
B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3 INSTALLATION

A. Install in accordance with manufacturer's instructions, approved submittals and in proper relationship with adjacent construction.

1. Install equipment firmly secured, plumb, and level.
2. Splices shall be in easily accessible junction boxes or on terminal boards.
3. Cable runs shall be tagged and identified at main terminal board and junction boxes.
4. Product should be configured in accordance with manufacturer-supplied hardening guide. Systems for which the manufacturer does not provide a hardened installation option are not be acceptable.

3.4 START-UP AND TESTING

A. Include all software necessary for system configuration.
B. Turn on system and make adjustments as necessary to meet indicated requirements.
C. Program system to function as specified.
D. Provide documentation of directory numbers, feature codes, and special programming.
E. Test system to assure audio server and all components, stations, speakers, and accessories are working properly.

3.5 DEMONSTRATION

A. Conduct up to four hours of instruction in use and operation of the system to designated owner representatives.
B. Conduct up to four hours of technical training, programming.
C. Program system to function as specified.
D. Provide documentation of directory numbers, feature codes, and special programming.
E. Test system to assure audio server and all components, stations, speakers, and accessories are working properly.

3.6 CLEANING AND PROTECTION

A. Clean products in accordance with the manufacturer’s recommendations.
B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION

SECTION 28 16 00 – INTRUSION DETECTION SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes intrusion detection with communication links to perform monitoring, alarm, and control functions.

B. This Section includes the following:

1. Intrusion Detection System
2. Door contacts
3. Glass breaks
4. Motion sensors
5. Duress buttons

1.2 RELATED SECTIONS

A. Section 260500 “Electrical Conduits – Security Supplement” provide conduit system requirements for security systems listed.

B. Section 280500.01 “Common Work Results for Electronic Security” provides overarching requirements for security systems (Access Control, and Intrusion Detection).

C. Section 280513.01 “Conductors and Cables for Electronic Security" for cabling between master control units and field-mounted devices and control units.

D. Section 281300 “Access Control System” that are used to control access to and throughout the facility and provide audit and reporting for all subsystems listed.

E. Section 281600 “Intrusion Detection System” are used to sense intruders and notify monitoring station of the intrusion event.

1.3 DEFINITIONS

A. Control Unit: System component that monitors inputs and controls outputs through various circuits.

B. Master Control Unit: System component that accepts inputs from other control units and may also perform control-unit functions. The unit has limited capacity for the number of protected zones and is installed at an unattended location or at a location where it is not the attendant's primary function to monitor the security system.

C. Monitoring Station: Facility that receives signals and has personnel in attendance at all times to respond to signals. A central station is a monitoring station that is listed.

D. Standard Intruder: A person who weighs 100 lb (45 kg) or less and whose height is 60 inches (1525 mm) or less; dressed in a long-sleeved shirt, slacks, and shoes.

E. Standard-Intruder Movement: Any movement, such as walking, running, crawling, rolling, or jumping, of a "standard intruder" in a protected zone.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Detail assemblies of standard components that are custom assembled for specific application on this Project.

1. Raceway Riser Diagrams: Detail raceway runs required for intrusion detection. Include designation of devices connected by raceway, raceway type and size, and type and size of wire and cable fill for each raceway run.

2. UPS: Sizing calculations.

3. Site and Floor Plans: Indicate final outlet and device locations, routing of raceways, and cables inside and outside the building.

4. Master Control-Unit Console Layout: Show required artwork and device identification.

5. Device Address List: Coordinate with final system programming.

6. System Wiring Diagrams: Include system diagrams unique to Project. Show connections for all devices, components, and auxiliary equipment. Include diagrams for equipment and for system with all terminals and interconnections identified.

7. Details of surge-protection devices and their installation.

8. Sensor detection patterns and adjustment ranges.

C. Equipment and System Operation Description: Include method of operation and supervision of each component and each type of circuit. Show sequence of operations for manually and automatically initiated system or equipment inputs. Description must cover this specific Project; manufacturer's standard descriptions for generic systems are unacceptable.

D. Samples: For units with factory-applied color finishes.

1.5 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

B. Warranty: Sample of special warranty.

C. Contractor to provide system submittals per requirements in Specifications Section 013300.

D. Follow installer qualifications submittal requirements identified in Section 28 05 00.01.

1.6 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

B. Contractor to provide system submittals per requirements in Specifications Section 013300.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Contractor to provide system submittals per requirements in Specifications Section 013300.

2. Intrusion Detection Devices: Furnish quantity equal to five percent of the number of units of each type installed, but no fewer than one of each type.

3. Fuses: Three of each kind and size.

4. Tool Kit: Provide six sets of tools for use with security fasteners, each packaged in a compartmented kit configured for easy handling and storage.

5. Security Fasteners: Furnish no fewer than 1 box for every 50 boxes or fraction thereof, of each type and size of security fastener installed.

1.8 QUALITY ASSURANCE

A. Installer Qualifications:

1. An employer of workers, at least one of whom is a technician certified by the National Burglar & Fire Alarm Association.

2. Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.

B. Testing Agency Qualifications: Member company of NETA or an NRTL.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

D. Control Units, Devices, and Communications with Monitoring Station: Listed and labeled by a qualified testing agency for compliance with SIA CP-01.

E. FM Global Compliance: FM-Approved and -labeled intrusion detection devices and equipment.

F. Comply with NFPA 70.

1.9 PROJECT CONDITIONS

A. Environmental Conditions: Capable of withstanding the following environmental conditions without mechanical or electrical damage or degradation of operating capability:

1. Altitude: Sea level to 600 feet (1220 m)

2. Master Control Unit: Rated for continuous operation in an ambient of 60 to 85 deg F (16 to 29 deg C) and a relative humidity of 20 to 80 percent, noncondensing.

3. Interior, Controlled Environment: System components, except master control unit, installed in temperature-controlled interior environments shall be rated for continuous operation in ambients of 36 to 122 deg F (2 to 50 deg C)] dry bulb and 20 to 90 percent relative humidity, noncondensing.

4. Interior, Uncontrolled Environment: System components installed in non-air-conditioned interior environments shall be rated for continuous operation in ambients of 0 to 122 deg F (minus 18 to plus 50 deg C) dry bulb and 20 to 90 percent relative humidity, noncondensing.

5. Exterior Environment: System components installed in locations exposed to weather shall be rated for continuous operation in ambients of minus 30 to plus 122 deg F (minus 34 to plus 50 deg C) dry bulb and 20 to 90 percent relative humidity, condensing. Comply with UL 294 and UL 639 for outdoor-use equipment. Rate for continuous operation when exposed to rain as specified in NEMA 250, winds up to 85 mph (137 km/h) and snow cover up to 24 inches (610 mm) thick.

6. Hazardous Environment: System components located in areas where fire or explosion hazards may exist because of flammable gases or vapors, flammable liquids, combustible dust, or ignitable fibers or flyings shall be rated, listed, and installed according to NFPA 70.

1.10 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer and Installer agree to repair or replace components of intrusion detection devices and equipment that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Two (2) years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANAUFACTURERS

A. Intrusion Detection System
1. Bosch 8512 Series Intrusion Detection System (Typical Components)
a. Bosch B9512G-C Kit
b. Bosch D1640 Transformer
c. Bosch B426 IP Ethernet Interface
d. Bosch B942 Color Touch Screen Keypad
e. Bosch B208 8 Zone Expander Module
f. Bosch B308 8 Relay Module
g. Bosch B520C Auxiliary Power Supply

B. General Requirements
1. Furnish and install a complete Intrusion Detection/ Access Control system with the performance criteria detailed in this specification. The system shall be inclusive of all necessary functions, monitoring, and control capability as detailed herein and on accompanying Shop drawings.
2. On-site or remote video monitoring Heating, air conditioning, and lighting management Temperature threshold detection and monitoring Humidity threshold detection and monitoring

3. Pressure threshold detection and monitoring Power loss detection and monitoring, generator switching Leak detection and monitoring Carbon Monoxide detection and monitoring
4. Tank level threshold detection and monitoring
5. This specification document provides the requirements for the installation, programming, and configuration of a complete Bosch panel. This system shall include, but not be limited to:
6. Control panel System cabinet Power supply
7. Digital Signaling Line Circuits (SLC) Notification Appliance Circuits (NAC) Annunciator/keypad bus
   a. Batteries Wiring Conduit
   b. Associated peripheral devices
   c. Other relevant components and accessories required to furnish and install a complete and operational addressable system.

C. Standards
1. The system shall be listed as a Power Limited Device and be listed under the standards below. Each system shall be supplied with complete details on all installation criteria necessary to meet all of the listings.

Burglary Listings	**U.S. Government Standards/Listings**
• UL 1023 Household Burglar Alarm System Units	• Meets ICD 705 Chapter 7 Intrusion Detection Systems (IDS)
• UL 1076 Proprietary Burglar	• Meets DoD/NIST SCIF Standards
• UL 1610 Central Station Burglar Alarm Units	• NIST Validated XR550E Encrypted Panel
• UL 1635 Digital Burglar Alarm Communicator System Units	**Intertek (ETL) Certifications**
Fire Listings	• EN 50130-4 EMC Product Family Standard: Immunity Requirements for Components of Fire, Intruder and Social Alarm Systems
• UL 985 Household Fire Warning	• EN 50130-5 Environmental Standards
• UL 864 Commercial Fire Warning	• EN 50131-1:2006+A1 Intrusion and hold-up systems
Access Control Listings	• EN 50131-3:2009 Control and Indicating Equipment
• UL 294 Access Control System Units	• EN 50131-5 Interconnections Equipment using Radio Frequency techniques
Related Standards	• EN 50131-6:2008 Power Supplies
• NFPA 70 National Electric Code (NEC)	• EN 50133-1:1997 Access Control Systems
• NFPA 72 Household Fire Warning	• EN 50136-1 Alarm Transmission Systems and Equipment
• System Monitors	• EN 50136-2:2013 Supervised Premises Transceiver
• System Events	• EN 50136-3 Receiving Centre Transceiver
	• EN 50131-6 Power Supplies

2. Americans with Disabilities
   a. All indicating and notification appliances shall comply with the Americans with Disabilities Act (ADA) requirements.

2.2 FUNCTIONAL DESCRIPTION OF SYSTEM

A. Description: Hard-wired, modular, microprocessor-based controls, intrusion sensors and detection devices, and communication links to perform monitoring, alarm, and control functions.

B. Supervision: System components shall be continuously monitored for normal, alarm, supervisory, and trouble conditions. Indicate deviations from normal conditions at any location in system. Indication includes identification of device or circuit in which deviation has occurred and whether deviation is an alarm or malfunction.

1. Alarm Signal: Display at master control unit and actuate audible and visual alarm devices.

2. Trouble Condition Signal: Distinct from other signals, indicating that system is not fully functional. Trouble signal shall indicate system problems such as battery failure, open or shorted transmission line conductors, or control-unit failure.

3. Supervisory Condition Signal: Distinct from other signals, indicating an abnormal condition as specified for the particular device or control unit.

C. System Control: Master control unit shall directly monitor intrusion detection units and connecting wiring.

D. System shall automatically reboot program without error or loss of status or alarm data after any system disturbance.

E. Operator Commands:

1. Help with System Operation: Display all commands available to operator. Help command, followed by a specific command, shall produce a short explanation of the purpose, use, and system reaction to that command.

2. Acknowledge Alarm: To indicate that alarm message has been observed by operator.

3. Place Protected Zone in Access: Disable all intrusion-alarm circuits of a specific protected zone. Tamper circuits may not be disabled by operator.

4. Place Protected Zone in Secure: Activate all intrusion-alarm circuits of a protected zone.

5. Protected Zone Test: Initiate operational test of a specific protected zone.

6. System Test: Initiate system-wide operational test.

7. Digital reports.

F. Timed Control at Master Control Unit: Allow automatically timed "secure" and "access" functions of selected protected zones.

G. Digital Record of Events: Digital a record of alarm, supervisory, and trouble events on system. Sort and report by protected zone, device, and function. When master control unit receives a signal, digitally send a report of alarm, supervisory, or trouble condition. Report type of signal (alarm, supervisory, or trouble), protected zone description, date, and time of occurrence. Differentiate alarm signals from other indications. When system is reset, report reset event with

the same information concerning device, location, date, and time. Commands shall initiate the reporting of a list of current alarm, supervisory, and trouble conditions in system or a log of past events.

H. Response Time: Two seconds between actuation of any alarm and its indication at master control unit.

I. Circuit Supervision: Supervise all signal and data transmission lines, links with other systems, and sensors from master control unit. Indicate circuit and detection device faults with both protected zone and trouble signals, sound a distinctive audible tone, and illuminate an LED. Maximum permissible elapsed time between occurrence of a trouble condition and indication at master control unit is 20 seconds. Initiate an alarm in response to opening, closing, shorting, or grounding of a signal or data transmission line.

J. Programmed Secure-Access Control: System shall be programmable to automatically change status of various combinations of protected zones between secure and access conditions at scheduled times. Status changes may be preset for repetitive, daily, and weekly; specially scheduled operations may be preset up to a year in advance. Manual secure-access control stations shall override programmed settings.

K. Manual Secure-Access Control: Coded entries at manual stations shall change status of associated protected zone between secure and access conditions.

2.3 SYSTEM COMPONENT REQUIREMENTS

A. Surge Protection: Protect components from voltage surges originating external to equipment housing and entering through power, communication, signal, control, or sensing leads. Include surge protection for external wiring of each conductor entry connection to components.

1. Minimum Protection for Power Lines 120 V and More: Auxiliary panel suppressors complying with requirements in Section 280500.01 "Common Work Results for Electronic Security."

2. Minimum Protection for Communication, Signal, Control, and Low-Voltage Power Lines: Listed and labeled by a qualified testing agency for compliance with NFPA 731.

B. Intrusion Detection Units: Listed and labeled by a qualified testing agency for compliance with UL 639.

C. Interference Protection: Components shall be unaffected by radiated RFI and electrical induction of 15 V/m over a frequency range of 10 to 10,000 MHz and conducted interference signals up to 0.25-V rms injected into power supply lines at 10 to 10,000 MHz.

D. Tamper Protection: Tamper switches on detection devices, control units, annunciators, pull boxes, junction boxes, cabinets, and other system components shall initiate a tamper-alarm signal when unit is opened or partially disassembled and when entering conductors are cut or disconnected. Master control-unit alarm display shall identify tamper alarms and indicate locations.

E. Self-Testing Devices: Automatically test themselves periodically, but not less than once per hour, to verify normal device functioning and alarm initiation capability. Devices transmit test failure to master control unit.

F. Antimasking Devices: Automatically check operation continuously or at intervals of a minute or less, and use signal-processing logic to detect blocking, masking, jamming, tampering, or other operational dysfunction. Devices transmit detection of operational dysfunction to master control unit as an alarm signal.

G. Addressable Devices: Transmitter and receivers shall communicate unique device identification and status reports to master control unit.

H. Remote-Controlled Devices: Individually and remotely adjustable for sensitivity and individually monitored at master control unit for calibration, sensitivity, and alarm condition.

2.4 ENCLOSURES

A. Interior Sensors: Enclosures that protect against dust, falling dirt, and dripping noncorrosive liquids.

B. Interior Electronics: NEMA 250, Type 12.

C. Screw Covers: Where enclosures are readily accessible, secure with security fasteners of type appropriate for enclosure.

2.5 GENERAL COMPONENT REQUIREMENTS

A. System Description
1. The system areas and zones shall be programmable, and the system shall store, log, display, and transmit specific custom designations for system areas, zones, and user names.
2. To ensure continued, one-call support, the system shall be constructed of sensing components provided directly by the system manufacturer, such as power supplies, motion detectors, door and window position switches, glass break detectors, or other sensing devices that the manufacturer offers.
3. The system controller, user interfaces, zone input devices, relay output devices, and the system signal receiving equipment shall be engineered, manufactured, assembled, and must be distributed from a location within the United States of America.
4. The system shall support user interaction by way of a keypad, web browser, system software, key switch, or radio frequency wireless control, Text messaging, or Smart Phone Application using integrated or auxiliary devices provided by the system manufacturer.
5. The system shall support controller zone input connections, system keypads, system zone expansion modules, and wireless zone input modules, and must support zone input connections by way of at least two competitive products. The system shall offer a seamless integrated compatibility with hard-wire and/ or wireless zone expansion equipment for at least 500 wireless zones and/ or a maximum of 574 hardwired zones.
6. The system shall be capable of offering up to five zone expansion buses, each of which can support the connection of up to 15,000 feet of four-wire cable. Zone expansion and keypad data buses that exceed 2,500 feet of cable must include splitter/repeater modules to boost data voltage and maintain data integrity.
7. The system shall provide a seamless capability to provide up to 506 addressable relays, which can be located at any connection location upon a zone expansion bus.
8. System relay outputs shall have the capability of being triggered as a result of a command from the user interface, changes in system status, changes in zone status, or by a programmable schedule.

9. System relay output states shall be programmable for momentary, maintained, pulsed, or must follow the state of an associated system zone input.
10. The system shall be completely programmable either locally from a keypad or remotely through a standard dial- up, and network connections by way of a LAN, WAN, and/or by way of the Internet, cellular communications paths.
11. The control unit shall be completely programmable remotely using remote annunciators, and/ or using upload/ download software that communicates using SDLC 300 baud, 2400 baud, or IP Addressed data network. On-site programming from a personal computer shall also be permitted.
12. The control unit shall be equipped with an anti-reversing circuit breaker to prevent damage due to accidental reversal of battery leads.

B. Input/Output Capacity
1. This system shall be capable of monitoring a maximum of 574 individual zones and controlling a maximum of 506 output relays.
2. The control panel shall have, as an integral part of the assembly, 2 SPDT Form C relays rated at 1 Amp at 30 VDC and four open collector 12 VDC outputs rated at 50mA each. It shall also have the capacity of a maximum of 125 output expander modules with 500 switched ground, open collector outputs, 50mA maximum and 506 auxiliary relays (Form C rated at 1.0 Amp at 30 VDC).
3. The panel shall also provide 99 programmable output profiles for schedules, and include an integral bell alarm circuit providing at least 1.5 Amps of steady, pulsed, or temporal bell output. Output type shall be programmable by zone type. Relays and voltage outputs shall be capable of being independently programmed to turn on and/or off at selected times each day.
4. The system shall be capable of supporting and controlling up to 140 Z-Wave devices and up to 20 Z-Wave Favorites for group control.

C. User Authorization Capacity
1. The system shall be capable of operation by 10,000 unique Personal Identification Number (PIN) codes with each code having one (1) of ninety-nine (99) custom user profiles. This allows for limitation of certain functions to authorized users. The operation of all keypads shall be limited to authorized users.

D. Keypads
1. The system shall support a maximum of sixteen (16) keypads on XR550 series with alphanumeric display. Each keypad shall be capable of arming and disarming any system area based on a pass code or Proximity key authorization. The keypad alphanumeric display shall provide complete promptmessages during all stages of operation and system programming and display all relevant operating and test data.
2. Communication between the control panel and all keypads and zone expanders shall be multiplexed over a non- shielded multi-conductor cable, as recommended by the manufacturer. This cable shall also provide the power to all keypads, zone expanders, output expanders, and other power consuming detection devices.
3. If at any time a keypad does not detect polling, the alphanumeric display shall indicate “SYSTEM TROUBLE”. If at any time two devices are programmed for the same address, the alphanumeric keypad shall display “4 WIREBUS TROUBLE”. If at any time a keypad detects polling but not for its particular address, the alphanumeric display shall indicate “NON POLLED ADDR”. The system shall display all system troubles at selected keypads with distinct alphanumeric messages.
4. The keypad shall include self-test diagnostics enabling the installer to test all keypad functions: display test, key test, zone test, LED test, relay test, tone test, and address test.

5. The keypad shall provide an easy-to-read English text display. The text shall exactly match the text seen inall software reports, keypad displays, and central station reports.
6. The keypad user interface shall be a simple-to-use, menu-driven help system that is completely user friendly.
7. The control panel shall support a keypad interface accessible on the World Wide Web in a browser window. The web-accessible keypad interface shall provide at least five (5) programmable hyperlinks for camera access or other use.

E. Zone Configuration
1. A minimum of 4 Class B ungrounded zones shall be available at each keypad or zone expander on the system. The system shall have the capacity for a maximum of sixteen (16) keypads and a maximum of 125 four (4) zone expanders or 500 single zone expanders on the XR550. It shall also have the capacity of a maximum of 125 supervised relay output expanders. The XR150 shall have the capacity for a maximum of eight (8) keypads and a maximum of 25 four (4) zone expanders It shall also have the capacity of a maximum of 25 supervised relay output expanders. All Class B zones shall be 2-wire, 22 AWG minimum, supervised by an end-of-line (EOL) device and shall be able to detect open and short conditions in excess of 500ms duration.
2. Each zone shall function in any of the following configurations: Night, Day, Exit, Fire, Supervisory, Emergency, Panic, Auxiliary 1, Auxiliary 2, Fire Verification, Cross Zone, Priority, and Key Switch Arming.
3. The digital SLCs and the annunciator/keypad bus shall be able to operate at a maximum wiring distance of 2500 feet from the control panel on unshielded, non-twisted cable. This distance may be extended to a total of 15,000 feet when bus repeater modules are installed.
4. Each zone shall function in any of the following configurations:

Night	Supervisory	Auxiliary 1	Cross-Zone
Day	Emergency	Auxiliary 2	Priority
Exit	Panic	Fire Verifica-tion	Arming
Fire	Doorbell	CO	

F. Communications
1. The system shall be capable of signaling to as many as 8 remote monitoring station receivers. Seven (7) of the eight (8) paths shall be capable of being assigned as either a “primary” or “backup” path. In such a manner the system shall have multiple primary paths to multiple remote monitoring stations as well as multiple backup paths to multiple monitoring stations.
2. The system shall employ Adaptive Technology that allows a Backup communication path programmed for Network or Cellular to automatically ADAPT to the faster check-in rate of the Primary path should the Primary path become unavailable. This creates a seamless transition for communication.
3. The system shall be capable of dialing up to (2) remote monitoring station receivers, four telephone numbers of 32 digits each using two separate switched telephone network lines such that if two unsuccessful attempts are made on the first line to the first number, the system shall make two attempts on first line to the second number. If these two attempts are unsuccessful, the system shall make two further attempts on the first line of the first number. After the tenth unsuccessful attempt, dialing shall stop and the alphanumeric keypad shall display trouble. Should another event occur that requires a

report to be transmitted, the dialing sequence shall be repeated. The system shall have a programmable option to dial a second set of telephone numbers after the first ten attempts using the same sequence.

4. The system shall be capable of communication using the IBM Synchronous Data Link Control format, and atleast one other standard industry format.
5. The system shall be capable of supporting Network communication with digital dialer backup, existing Ethernet data networks, satellite communication, fiber optic networks, local area networks, wide area networks, cellular communication, and retail data networks.

G. Network Communications

1. The control panel shall be capable of asynchronous network communication with a retry time between 2 and 240 minutes and a fail time of 2 and 240 minutes. If communication is unsuccessful the control panel shall be capable of attempting backup communication through any of the available communication methods to thesame receiver or a backup receiver.
2. The control panel shall employee adaptive communication technology. Adaptive Technology allows a Backup communication path programmed to use Network or Cellular to automatically ADAPT to the faster check-in rate of the Primary path should the Primary path become unavailable, creating a seamless transition for communication of messages. Select Adapt when programming the Checkin option. This allows a system to be fully supervised even if a path fails, while also keeping wireless charges low when the network isgood.
3. Network communication between the control panel and the receiver shall be in a proprietary communication format.
4. The control panel shall be capable of supporting Dynamic Host Communication Protocol (DHCP) Internet Protocol (IP) addressing.
5. Underwriters Laboratories (UL) shall list network communication by the control panel for Standard orEncrypted Line Security.
6. The control panel shall be capable of two-way network communication using standard Ethernet 10/100 BaseT in a LAN, WAN, or Internet configuration.
7. The control panel shall be capable of communication by means of a 128- & 256-Bit AES (Advanced Encryption Standard) Encryption process certified by NIST (National Institute of Standards and Technology) to an SCS-1R receiver with a built-in Encryption Alarm Router or SCS-VR.
8. The control panel shall be capable of meeting ICD 705 Chapter 7 Intrusion Detection Systems (IDS) and UL 2050 standards.
9. The control panel shall be capable of sending text messaging to up to three Cellular Phone Numbers using cellular communications.
10. The control panel shall be capable of sending the following Text messages:

Zone Alarms by Zone Name	AC Power Trouble and Restoral
Zone Troubles by Zone Name	System Low Battery
Zone Bypass by User	Ambush
Arming (Closings) by User	Abort, Cancel and Alarm Verified by User
Disarming (Openings) by User	Check-in by user
Late to Close	

H. Component Enclosure

1. Housings; power supply enclosures, terminal cabinets, control units, and other component housings, collectively referred to as enclosures shall be so formed and assembled as to be sturdy and rigid. If sheet steel is used in the fabrication of enclosures,

it shall be not less than an 18-gauge door with a 20-gauge box frame. Where exposed pins, the hinges shall be of the tight pin type or the ends of hinge pins shall be tack welded to prevent ready removal. Doors having a latch edge length of less than 24 inches shall be provided with a single lock. Where the hinged door latch edge is 24 inches or more in length, doors shall be provided with three-point latching device with lock; or alternatively with two locks, one located near each end. For SCIF and High Security applications an attack proof enclosure with proper tampers listed for use with the XR150/XR550 with Network and Encryption shall be used.

I. Electronic Components

1. All system electronic components shall be solid-state type, mounted on printed circuit boards. Light duty relays and similar switching devices shall be solid-state type or electromechanical.
2. The panel shall have an over current notification LED that lights when devices connected to the Keypad Bus and Loop Expansion LX-Bus(es) draw more current than the panel is rated for. When the over current LED lights, the Loop Expansion LX-Bus (es) and Keypad bus are shut down.

J. Control Unit

1. A battery test shall be automatically performed to test the integrity of the standby battery. The test shall disconnect the standby battery from the charging circuit and place a load on the battery. This test shall be performed no more than every 180 seconds.
2. The control unit shall be capable of operating and supervising notification appliance devices as well as addressable initiating detection devices and an integrated supervised dual line digital communicator.
3. Control unit must be “Flash ROM” updatable, and program must be held in non-volatile RAM. The panel shall be able to function while the update is in process.
4. Control unit shall be capable of operating using an optional built in Encrypted Alarm Router for SCIF (Sensitive Compartmented Information Facility) applications that is certified by NIST (National Institute of Standards and Technology) for 128- & 256-Bit AES (Advanced Encryption Standard) Encryption communications.
5. The optional built-in Encrypted Alarm Router shall be capable of compliance with ICD 705 Chapter 7 Intrusion Detection Systems (IDS) and UL 2050 standards.

K. Remote Annunciators

1. The system shall support a maximum of sixteen (16) supervised remote annunciators with the identical capabilities, functions and display layout. Operation of the remote annunciators shall be limited to authorized users by the use of a code or key.
2. The remote annunciators shall be capable of operating at a maximum wiring distance of 15,000 feet from the control unit on unshielded, non-twisted cable.

L. Control Designations

1. Controls shall be provided to ensure ease of operation of all specified characteristics. Where applicable, clockwise rotation of controls shall result in an increasing function. Controls, switches, visual signals and indicating devices, input and output connectors, terminals and test points shall be clearly marked or labeled on the hardware to permit quick identification of intended use and location.

M. Test Modes

1. The system shall include a provision that permits testing from any alphanumeric keypad. The test shall include standby battery, alarm bell or siren, and communication to the central station.

2. The system shall include a provision for an automatic, hourly, daily, weekly, thirty (30) day, or up to sixty (60) day communication link test from the control panel installation site to the central station.
3. The system shall include a provision for displaying the internal system power and wiring conditions. Internal monitors shall include the bell circuit, AC power, battery voltage level, charging voltage, panel box tamper, phone trouble line 1, phone trouble line 2, transmit trouble, and network trouble.

N. Power Supplies

1. Power supplies for the control unit shall operate from 120 VAC, supplied at the respective protected areas. Standby batteries shall be supplied to power the system in the event of a utility power failure. Batteries shall be sized to provide 105% capacity for eight hours. Standby batteries shall be sealed lead-acid. Power supplies shall be all Solid State.
2. Controls shall be designed to maintain full battery charge when alternating current is available. Batteries shall be recharged to 85% capacity within 24 hours from battery use. The system shall be automatically transferred to battery power upon loss of alternating current power and return to alternating current power upon restoration. Intrusion alarms shall not be initiated during switch over; a signal shall be initiated upon failure of battery or alternating current power.
3. Approved power supplies shall meet or exceed the following power supply model specifications: UL Listed DMP 505-12: 12VDC 5 Amp with transformer and enclosure.

O. Software

1. The system shall interface with computer software with the capability to fully program the panel by connecting to the panel through:
2. Direct cable connection interface card Receiver phone line connection Standard phone line connection Ethernet network connection

P. Network connection across the Internet

1. The system shall interface with computer software capable of locking down all controlled doors.
2. The system shall interface with computer software capable of monitoring and logging all events.
3. The system shall interface with computer software or Cloud-based managed software or mobile app accessible by a standard web browser using a login and password and requiring the system user code or PIN code upon remote login to be capable of exporting reports in the following file formats:
    a. Excel Spreadsheet (.xls)
    b. Comma-separated (.csv)

4. The system shall interface with computer software capable of printing custom, filtered reports including:
    a. All Events
    b. Door Access Granted
    c. Zone Action
    d. Door Access Denied
    e. Arming/Disarming
    f. Opening/Closing Schedule Changes
    g. Area Late to Close
    h. System Monitors
    i. User Code Changes
    j. System Events

Q. INTEGRATION
1. Genetec Security Center

2.6 SENSORS

A. 360 Degree Dual-tech Motion Sensor
1. Acceptable Manufacturers
a. Bosch
b. Approved Equivalent
2. Bosch DS9370 and DS9371 or approved equivalent.
3. Minimum Features and Specifications
a. Up to 25 ft (7.6 m) mounting height
b. 360 degrees x 70 ft (20 m) diameter pattern
c. Fully-adjustable optical arrays for coverage customization
d. Rated for use in difficult environment to reduce false alarms from background disturbances such as air movement and hanging signs.
e. Combination of passive infrared (PIR) detection, microwave detection, and advanced signal processing technology.
f. Built-in tamper switch
g. Operating Temperature: -40 to 120 deg F (-40 to 49 deg C)
h. Dimensions: 3.5 x 7 in (8.9 x 17.8 cm)
i. Voltage: 9 to 15 VDC
j. UL Listed

B. Directional Dual-tech Motion Sensor
1. Acceptable Manufacturers
a. Bosch
b. Approved Equivalent
2. Bosch ISC-CDL1-WA15G or approved equivalent
3. Minimum Features and specifications
a. Combination of passive infrared (PIR) detection, microwave detection, and advanced signal processing technology.
b. Active infrared ant-masking
c. Microwave noise adaptive processing
d. Mounting height: 7.5 x 9 ft (2.3 x 2.75 m)
e. Coverage Pattern: 50 x 50 ft (15 x 15 m)
f. Built-in tamper switch
g. Operating Temperature: 32 to 120 deg F (0 to 49 deg C)
h. Dimensions: 4.7 x 2.75 x 2.2 in (12 x 7 x 5.5 cm)
i. Voltage: 9 to 15 VDC
j. UL Listed

C. Curtain PIR Motion Sensor
1. Acceptable Manufacturers
a. Honeywell
b. Approved Equivalent
2. Honeywell IS216T-CUR or approved equivalent
3. Minimum Features and specifications
a. Dual element passive infrared
b. Mounting height: 5 x 8.8 ft (1.5 x 2.7 m)
c. 32 ft (10 m) in vertical mount position
d. Operating temperature: 14 to 131 deg F (-10 to 55 deg C)

e. Dimensions: 3.4 x 2.4 x 1.5 in (8.6 x 6 x 3.8 cm)
f. Supply Voltage: 8.5 to 15.4 VDC (12 VDC nominal)

D. Long-range Dual-tech Motion Sensor
1. Acceptable Manufacturers
a. Honeywell
b. Approved Equivalent
2. Honeywell DT900 or approved equivalent
3. Minimum Features and specifications
a. Combination of passive infrared (PIR) detection, microwave detection, and advanced signal processing technology.
b. Mounting height: 2 to 3.7 m (6 to 12 ft)
c. Coverage Pattern:
1) 50 x 40 ft (15 x 12 m), and 90 x 70 ft (27 x 21 m)]
d. Built-in housing tamper switch
e. DT900: Anti-masking using active infrared look-down lens]
f. DT900: Detector mount tamper switches (2)]
g. Operating Temperature: 32 to 120 deg F (0 to 49 deg C)
h. Dimensions: 8 x 6.5 x 6 in (20 x 17 x 15 cm)
i. Voltage: 10 VDC to 15 VDC, 12 VDC nominal
j. UL Listed

E. Long-range PIR
1. Acceptable Manufacturers
a. Bosch
b. Approved Equivalent
2. Bosch DS778 Long Range PIR Detector or approved equivalent
3. Minimum Features and specifications
a. Mounting height: 6.5 x 8.5 ft (2 x 2.6 m)
b. Coverage: 200 x 15 ft (60 x 4.5 m)
c. Built-in tamper switch
d. Operating Temperature: -40 to 120 deg F (-40 to 49 deg C)
e. Dimensions: 5.75 x 3.75 x 2.5 in (14.6 x 9.5 x 6.35 cm)
f. Voltage: 6 to 15 VDC
g. UL Listed

F. Glass Break Detector, Acoustic
1. Acceptable Manufacturers
a. Honeywell
b. Approved Equivalent
2. Honeywell FG-730 or approved equivalent
3. Minimum Features and specifications
a. Analysis of both impact and shattering frequencies
b. Signal verification
c. Coverage: 30 ft (90 m), minimum glass size: 11 x 11 in (27.9 x 27.9 cm)
d. Operating temperature: 32 to 120 deg F (0 to 49 deg C)
e. Supply Voltage: 10 to 14VDC (12 VDC nominal)
f. Mounting locations: Ceiling, opposite wall, adjoining wall, same wall as glass

G. Door Position Switch; Recessed
1. Acceptable Manufacturers
a. Magnasphere
b. Approved Equivalent

2. Magnasphere MSS-20 Series, MSS-26 Series for Normally Closed Loop or approved equivalent
3. Magnasphere MSS-19 Series, MSS-25 Series for Normally Open Loop or approved equivalent
4. Minimum Features and Specifications
    a. UL 634 Listed
    b. Recessed
    c. Magnetic tamper
    d. 0.75 in (19 mm) or 1 in (25.4 mm) diameter
    e. Capable of operating with a 0.5 in (13 mm) gap
    f. Screw Terminals or 12 in (305 mm) wire leads, #22 AWG, solid

H. Door Position Switch; Surface
1. Acceptable Manufacturers
    a. Magnasphere
    b. Approved Equivalent
2. Magnasphere MSS-30XS Series or approved equivalent
3. Minimum Features and Specifications
    a. UL 634 Listed
    b. Surface mounted
    c. Magnetic tamper
    d. Size: 2 x 0.5 x 1 in (51 x 12.7 x 25.4 mm).
    e. Capable of operating with a 0.3 in (7.6 mm) gap
    f. Armored cable lead 24 in (61 mm)
    g. Only for use on hatches where a standard recessed contact cannot be used

I. Door Position Switch; Overhead
1. Acceptable Manufacturers
    a. Magnasphere
    b. Approved Equivalent
2. Magnasphere MSS-105S or approved equivalent
3. Minimum Features and Specifications
    a. UL 634 listed
    b. Surface Mounted with overhead door bracket
    c. Capable of operating with a 0.5 inch gap
    d. Magnetic tamper
    e. 5 ft (1.5 m) leads

J. Door Position Switch, UL Level 1, Surface
1. Acceptable Manufacturers
    a. Magnasphere
    b. Approved Equivalent
2. Magnasphere HS-L1.5 Series or approved equivalent
3. Minimum Features and Specifications
    a. UL 634, Level 1 high security (both in-swing and out-swing doors)
    b. Surface mounted
    c. External and internal magnetic tamper
    d. Size: 4.25 x 1 x 1 in (108 x 25.4 x 25.4 mm).
    e. Capable of operating with a 0.25 in (6.35 mm) gap
    f. Wire leads, #22 AWG, solid, in 18 in (457 mm) armored cable
    g. Housing: Aluminum case, silver-gray anodized
    h. Dual alarm contacts – Use for both IDS and ACS (two closed loop or one closed loop / one open loop)

i. NO adjustment required for installation
j. NO brackets needed for most out-swing door installations
k. Integrated removal / pry tamper (no back plates)

K. Door Position Switch; High Security, Recessed
1. Acceptable Manufacturers
a. Magnasphere
b. Approved Equivalent
2. Magnasphere HSS-L2C or HSS-L2C-A or approved equivalent
3. Minimum Features and Specifications
a. UL 634 Level 2 High Security Listed
b. Recessed
c. Integrated Removal Tamper Circuit and hardware, to actuate on removal of
d. switch from mounting surface
e. Used with, or contain embedded End of Line (EOL) resistors compatible with Software House control panels
f. Rated for both indoor and outdoor use
g. Qualify as an Intrinsically Safe - Simple Apparatus.
h. Installable in either a 1 in (25.4 mm) diameter hole or standard ANSI door cutout
i. Capable of operating with a 0.0625 in (1.5875 mm) gap
j. Wire leads, #22 AWG, solid, 12 in (305 mm) length
k. Brass magnet housing, ABS switch housing

L. Door Position Switch; High Security Surface
1. Acceptable Manufacturers
a. Magnasphere
1) Approved Equivalent
2. Magnasphere HSS-L2S Series or approved equivalent
3. Minimum Features and Specifications
a. UL 634, Level 2 listed
b. Surface mounted
c. Integrated Removal Tamper Circuit and hardware, to actuate on removal of
d. switch from mounting surface
e. Used with, or contain embedded End of Line (EOL) resistors compatible with Software House control panels
f. Rated for both indoor and outdoor use
g. Qualify as an Intrinsically Safe - Simple Apparatus.
h. Size: 4.25 x 1.5 x 1 in (108 x 38 x 25.4 mm).
i. Capable of operating with a 0.125 in (3.18 mm) gap
j. Wire leads, #22 AWG, solid, in 36 in (91.4 cm) armored cable
k. Housing: Aluminum case, silver-gray anodized
4. Additional Required Options / Parts
a. HSS Roll-up Door Bracket Kit for use on overhead doors

M. Vibration Detector
1. Acceptable Manufacturers
a. Bosch
b. Approved Equivalent
2. Bosch ISN-SM-80, or approved equivalent.
3. Minimum Features and Specifications
a. 5 m operating radius on concrete
b. Dimensions: 3.5 x 3.5 x .86 in (8.9 x 8.9 x 2.2 cm)
c. Operating temperature: -40 to 158 deg F (-40 to 70 deg C)

d. Supply Voltage: 8 to 16 VDC (12 VDC nominal)

N. Vibration Detector, Solid state
1. Acceptable Manufacturers
   a. George Risk Industries, Inc.
   b. Approved Equivalent
2. GRI Shockgard 1 SG-1 or approved equivalent.
3. Minimum Features and Specifications
   a. 12 in (30.5 cm) operating radius on steel
   b. Dimensions: .91 x .98 x 3.4 in (2.3 x 2.5 x 8.6 cm)
   c. Operating temperature: -4 to 140 deg F (-20 to 60 deg C)
   d. Supply Voltage: 9 to 15 VDC, Regulated

O. Duress Alarm
1. Acceptable Manufacturers
   a. Honeywell
   b. Approved Equivalent
2. Honeywell 269R/270R/269SN or approved equivalent.
3. Minimum Features and Specifications
   a. Switch with a shroud over the activating lever that allows an individual to covertly send a duress signal to master control unit, with no visible or audible indication when activated. Switch shall lock in activated position until reset with a key.
   b. Push Button: Finger activated, suitable for mounting on horizontal or vertical surface.
   c. Latching with key reset
   d. Plunger type DPDT
   e. Switch rating: 0.2A @ 30VDC max
   f. Operating Temperature: 14 to 140 deg F (-10 to 60 deg C)
   g. UL 636 listed
   h. Honeywell 269R: stainless steel cover
   i. Honeywell 270R: plastic case
   j. Honeywell 269SN: stainless steel cover (polling loop only)

P. AUDIBLE AND VISUAL ALARM DEVICES
1. See Editing Instruction No. 1 in the Evaluations for cautions about naming manufacturers. Retain one of first two paragraphs and list of manufacturers below. See Section 016000 "Product Requirements."
2. Bell: Master control unit 10 inches (254 mm) in diameter, rated to produce a minimum sound output of 84 dB at 10 feet (3 m) from master control unit.
   a. Enclosure: Weather-resistant steel box equipped with tamper switches on cover and on back of box.
3. Klaxon Weatherproof Motor-Driven Hooter: UL listed, rated to produce a minimum sound output of 120 dB at 3 feet (1 m), plus or minus 3 dB, at a frequency of 470 Hz. Rated for intermittent use: two minutes on and five minutes off.
4. Designed for use in industrial areas and in high-noise, severe-weather marine environments.
5. Siren: 30-W speaker with siren driver, rated to produce a minimum sound output of 103 dB at 10 feet (3 m) from master control unit.
   a. Enclosure: Weather-resistant steel box with tamper switches on cover and on back of box.
6. Strobe: Xenon light complying with UL 1638, with a clear polycarbonate lens.
   a. Light Output: 115 cd, minimum.
   b. Flash Rate: 60 per minute.

2.7 SECURITY FASTENERS

A. Operable only by tools produced for use on specific type of fastener by fastener manufacturer or other licensed fabricator. Drive system type, head style, material, and protective coating as required for assembly, installation, and strength.

B. Drive System Types: Pinned Torx-Plus

C. Socket Flat Countersunk Head Fasteners:

1. Heat-treated alloy steel, ASTM F 835 (ASTM F 835M).

2. Stainless steel, ASTM F 879 (ASTM F 879M), Group 1 CW.

D. Socket Button Head Fasteners:

1. Heat-treated alloy steel, ASTM F 835 (ASTM F 835M).

2. Stainless steel, ASTM F 879 (ASTM F 879M), Group 1 CW.

E. Socket Head Cap Fasteners:

1. Heat-treated alloy steel, ASTM A 574 (ASTM A 574M).

2. Stainless steel, ASTM F 837 (ASTM F 837M), Group 1 CW.

F. Protective Coatings for Heat-Treated Alloy Steel:

1. Zinc chromate, ASTM F 1135, Grade 3 or Grade 4, for exterior applications and interior applications where indicated.

2. Zinc phosphate with oil, ASTM F 1137, Grade I, or black oxide unless otherwise indicated.

PART 3 - EXECUTION

3.1 SYSTEM INSTALLATION

A. Comply with UL 681 and NFPA 731.

B. Equipment Mounting: Install master control unit on finished floor with tops of cabinets not more than 72 inches (1830 mm) above the finished floor.

1. Comply with requirements for seismic-restraint devices specified in Section 280500.01 "Common Work Results for Electronic Security."

C. Install wall-mounted equipment, with tops of cabinets not more than 72 inches (1830 mm) above the finished floor.

1. Comply with requirements for seismic-restraint devices specified in Section 280500.01 "Common Work Results for Electronic Security.

D. Connecting to Existing Equipment: Verify that existing perimeter security system is operational before making changes or connections.

1. Connect new equipment to existing control panel in existing part of the building.

2. Connect new equipment to existing monitoring equipment at the Supervising Station.

3. Expand, modify, and supplement existing monitoring equipment as necessary to extend existing monitoring functions to the new points. New components shall be capable of merging with existing configuration without degrading the performance of either system.

E. Security Fasteners: Where accessible to inmates, install intrusion detection components using security fasteners with head style appropriate for fabrication requirements, strength, and finish of adjacent materials except that a maximum of two different sets of tools shall be required to operate security fasteners for Project.

3.2 WIRING INSTALLATION

A. Wiring Method: Install wiring in metal raceways according to Section 260500 "Electrical Conduit (Security Supplement)." Conceal raceway except in unfinished spaces and as indicated. Minimum conduit size shall be 1/2 inch (13 mm). Control and data transmission wiring shall not share conduit with other building wiring systems.

B. Wiring Method: Install wiring in metal raceways according to Section 260500 "Electrical Conduit (Security Supplement)," except in accessible indoor ceiling spaces and in interior hollow gypsum board partitions where cable may be used. Conceal raceways and wiring except in unfinished spaces and as indicated. Minimum conduit size shall be 1/2 inch (13 mm). Control and data transmission wiring shall not share conduit with other building wiring systems.

C. Wiring Method: Cable, concealed in accessible ceilings, walls, and floors when possible.

D. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points. Use lacing bars and distribution spools. Separate power-limited and non-power-limited conductors as recommended in writing by manufacturer. Install conductors parallel with or at right angles to sides and back of enclosure. Connect conductors that are terminated, spliced, or interrupted in any enclosure associated with intrusion system to terminal blocks. Mark each terminal according to system's wiring diagrams. Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.

E. Wires and Cables:

1. Conductors: Size as recommended in writing by system manufacturer unless otherwise indicated.

2. 120-V Power Wiring: Install according to Section 260500 "Electrical Conduit (Security Supplement)" unless otherwise indicated.

3. Control and Signal Transmission Conductors: Install unshielded, twisted-pair cable unless otherwise indicated or if manufacturer recommends shielded cable, according to Section 280513 "Conductors and Cables for Electronic Safety and Security."

4. Data and Television Signal Transmission Cables: Install according to Section 280513 "Conductors and Cables for Electronic Safety and Security."

F. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

G. Install power supplies and other auxiliary components for detection devices at control units unless otherwise indicated or required by manufacturer. Do not install such items near devices they serve.

H. Identify components with engraved, laminated-plastic or metal nameplate for master control unit and each terminal cabinet, mounted with corrosion-resistant screws. Nameplates and label products are specified in Section 260500 "Electrical Conduits (Security Supplement) and 280513.01 Conductors and Cabling for Electronic Security."

3.3 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with identification requirements in Sections 260500 "Electrical Conduits (Security Supplement) and 280513.01 Conductors and Cabling for Electronic Security."

B. Install instructions frame in a location visible from master control unit.

3.4 GROUNDING

A. Ground the master control unit and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to master control unit.

B. Ground system components and conductor and cable shields to eliminate shock hazard and to minimize ground loops, common-mode returns, noise pickup, cross talk, and other impairments.

C. Signal Ground Terminal: Locate at main equipment rack or cabinet. Isolate from power system and equipment grounding. Provide [5] <Insert value>-ohm ground. Measure, record, and report ground resistance.

D. Install grounding electrodes of type, size, location, and quantity indicated. Comply with installation requirements in Section 280500.01 "Common Results for Electronic Security."

3.5 FIELD QUALITY CONTROL

A. Pretesting: After installation, align, adjust, and balance system and perform complete pretesting to determine compliance of system with requirements in the Contract Documents. Correct deficiencies observed in pretesting. Replace malfunctioning or damaged items with new ones and retest until satisfactory performance and conditions are achieved. Prepare forms for systematic recording of acceptance test results.

1. Report of Pretesting: After pretesting is complete, provide a letter certifying that installation is complete and fully operable; include names and titles of witnesses to preliminary tests.

B. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

C. Tests and Inspections: Comply with provisions in NFPA 731, Ch. 9, "Testing and Inspections."

1. Inspection: Verify that units and controls are properly labeled and interconnecting wires and terminals are identified.

2. Test Methods: Intrusion detection systems and other systems and equipment that are associated with detection and accessory equipment shall be tested according to Table "Test Methods" and Table "Test Methods of Initiating Devices."

D. Documentation: Comply with provisions in NFPA 731, Ch. 4, "Documentation."

E. Tag all equipment, stations, and other components for which tests have been satisfactorily completed.

3.6 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain the intrusion detection system. Comply with documentation provisions in NFPA 731, Ch. 4, "Documentation and User Training."

END OF SECTION

SECTION 28 23 00 – VIDEO SURVEILLANCE SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes a video surveillance system consisting of cameras, digital video recording systems, data transmission wiring, and a control station with its associated equipment. These systems will become a component of a larger video assessment system. Video Surveillance system will be required to record and retain video at full resolution and 15 frames per second for a period of 30 days.

B. Related Sections

1. Section 280500.01 “Common Work Results for Electronic Security”
2. Section 280513 "Conductors and Cables for Electronic Safety and Security" for cabling between master control units and field-mounted devices and control units.
3. Section 281600 “Intrusion Detection that provide sensor level intrusion for and throughout the facility and vehicle parking areas and utility areas

1.3 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Video surveillance system shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

B. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

1.4 ACTION SUBMITTALS

A. Contractor to provide system submittals per requirements in Specifications Section 013300.

B. Product Data: For each type of product indicated. Include dimensions and data on features, performance, electrical characteristics, ratings, and finishes.

C. Retain first paragraph below if custom equipment, such as operator panels and consoles, is specified in this Section. Coordinate with Drawings.

D. Shop Drawings: For video surveillance. Include plans, elevations, sections, details, and attachments to other work.

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
2. Functional Block Diagram: Show single-line interconnections between components for signal transmission and control. Show cable types and sizes.
3. Dimensioned plan and elevations of equipment racks, control panels, and consoles. Show access and workspace requirements.
4. UPS: Sizing calculations.
5. Retain subparagraph below if equipment includes wiring.
6. Wiring Diagrams: For power, signal, and control wiring.

E. Equipment List: Include every piece of equipment by model number, manufacturer, serial number, location, and date of original installation. Add pretesting record of each piece of equipment, listing name of person testing, date of test, set points of adjustments, name and description of the view of preset positions, description of alarms, and description of unit output responses to an alarm.

1.5 INFORMATIONAL SUBMITTALS

A. Retain first paragraph below if required by seismic criteria applicable to Project. Coordinate with Sections specifying electrical supports and seismic controls. See ASCE/SEI 7 for certification requirements for equipment and components.

B. Seismic Qualification Certificates: For video surveillance, cameras, camera-supporting equipment, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

    a. Field quality-control reports.
    b. Warranty: Sample of special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For cameras, power supplies, infrared illuminators, monitors, videotape recorders, digital video recorders, video switches, and control-station components to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 01 70 00 "Execution and Closeout Requirements," include the following:

1. Lists of spare parts and replacement components recommended to be stored at the site for ready access.

1.7 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with NECA 1.

C. Comply with NFPA 70.

D. Retain paragraph below if integrating video surveillance system with access-control system.

E. Electronic data exchange between video surveillance system with an access-control system shall comply with SIA TVAC.

1.8 PROJECT CONDITIONS

A. Environmental Conditions: Capable of withstanding the following environmental conditions without mechanical or electrical damage or degradation of operating capability:

1. Retain subparagraphs below; revise conditions and specify features required to provide satisfactory service. See Editing Instruction No. 2 in the Evaluations for discussion of service conditions.
2. Control Station: Rated for continuous operation in ambient temperatures of 60 to 85 deg F (16 to 29 deg C) and a relative humidity of 20 to 80 percent, noncondensing.
3. Interior, Controlled Environment: System components, except central-station control unit, installed in air-conditioned interior environments shall be rated for continuous operation in ambient temperatures of 36 to 122 deg F (2 to 50 deg C) dry bulb and 20 to 90 percent relative humidity, noncondensing. Use NEMA 250, Type 1 enclosures.
4. Interior, Uncontrolled Environment: System components installed in non-air-conditioned interior environments shall be rated for continuous operation in ambient temperatures of [0 to 122 deg F (minus 18 to plus 50 deg C) dry bulb and 20 to 90 percent relative humidity, noncondensing. Use NEMA 250, Type 12 enclosures.
5. Exterior Environment: System components installed in locations exposed to weather shall be rated for continuous operation in ambient temperatures of minus 30 to plus 122 deg F (minus 34 to plus 50 deg C) dry bulb and 20 to 90 percent relative humidity, condensing. Rate for continuous operation when exposed to rain as specified in NEMA 250, winds up to 85 mph (137 km/h) and snow cover up to 24 inches (610 mm) thick]. Use NEMA 250, Type 4X enclosures.
6. Hazardous Environment: System components located in areas where fire or explosion hazards may exist because of flammable gases or vapors, flammable liquids, combustible dust, or ignitable fibers shall be rated, listed, and installed according to NFPA 70.
7. Corrosive Environment: System components subject to corrosive fumes, vapors, and wind-driven salt spray in coastal zones. Use NEMA 250, Type 4X enclosures.
8. Security Environment: Camera housing for use in high-risk areas where surveillance equipment may be subject to physical violence.

1.9 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of cameras, equipment related to camera operation, and control-station equipment that fail in materials or workmanship within specified warranty period.

1. Warranty Period: FIve years from date of acceptance.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. The following are acceptable manufacturers of electronic security system products as specified in this specification section. Any proposed product from a different manufacturer is subject to the review and approval.

1. Video Management System:

    a. Genetec
    b. Approved equal

2. Network Cameras

    a. Axis
    b. Approved equal

3. Video Monitors Client

    a. Refer to Section – Refer to Section 28 05 31.10

2.2 VMS GENERAL REQUIREMENTS

A. The VMS shall support updating its camera drivers independent from the VMS installation. New drivers shall be released multiple times a year to extend support for new devices and features.

B. The VMS shall be based on a true open architecture that shall allow the use of non-proprietary workstation and server hardware, non-proprietary network infrastructure, and non-proprietary storage.

C. The VMS shall offer a complete and scalable video surveillance solution that shall allow cameras to be added on a unit-by-unit basis.

D. The VMS shall interface with analog-to-digital video encoders and IP cameras and with digital-to-analog video decoders, hereafter referred to as digital video servers (DVS). The VMS shall support DVS from various manufacturers.

E. The VMS shall integrate DVS using the DVS native SDK or using the following industry standards to interface to the DVS:

1. ONVIF

F. All video streams supplied from analog cameras or IP cameras shall be digitally encoded in H.265, H.264, MPEG-4, MPEG-2, MJPEG, MxPEG, Wavelet, or JPEG2000 compression formats and recorded simultaneously in real time.

G. All audio streams supplied from IP video servers shall be digitally encoded in g711 (u-law), g721, g723, or AAC compression formats and recorded simultaneously in real time.

H. Each camera's bit rate, frame rate, and resolution shall be set independently from other cameras in the system and altering these settings shall not affect the recording and display settings of other cameras.

I. The VMS shall be able to use multiple CCTV keyboards to operate the entire set of cameras throughout the system, including brands of cameras from various manufacturers and including their PTZ functionalities (i.e. Pelco keyboard controls Panasonic dome or vice-versa).

J. The VMS shall be able to retrieve and set the current position of PTZ cameras using XYZ coordinates.

K. The VMS shall support PTZ camera protocols from multiple manufacturers, including analog and IP protocols.

L. The VMS shall arbitrate the user conflict on PTZ usage based on user levels per camera.

M. The VMS shall support the following list of CCTV keyboard:

1. American Dynamics 2078 ASCII, and American Dynamics 2088 ASCII
2. Bosch Autodome, Bosch Intuikey
3. DVTel
4. GE ImpactNet
5. Panasonic, Pelco ASCII, Pelco KBD-300, Pelco 9760, and Pelco P.
6. Radionics
7. Hanwha Techwin SSC-100, SPC-600, SPC-2010, SPC-6000, and SPC-7000.
8. Videoalarm
9. Sony RM-NS1000
10. Panasonic WV-CU161C
11. Panasonic WV-CU950 Ethernet keyboard

N. The VMS shall support the following list of joysticks:

1. Axis 295
2. Axis T8310, T8311, T8312, T8313 Video Surveillance Control Board
3. Any USB joystick detected as a Windows Game Controller

O. The VMS shall support password change for the following list of video units:

1. Avigilon H3 and H4 series.
2. Axis: All units with firmware 6.50 or later.
3. Bosch: All units with firmware 6.30 or later.
4. Hanwha: The following series are supported:

    a. All X-Series (all firmwares)
    b. All PNx-Series (firmwares 1.01 and later)
    c. All SPE-xx10 (all firmwares), excluding SPE-100, SPE-400, SPE-101
    d. All Q-Series (all firmwares), excluding QNO-6010R, QNO-6020R, QNO-6030R, QND-6010R, QND-6020R, QND-6030R, QNV-6010R, QNV-6020R, QNV-6030R, QNE-6080RV, QNE-7080RV
    e. All L-Series (all firmwares)
    f. All TNx Series (all firmwares) excluding TNU-6320

5. ONVIF : Profile S compatible.
6. Panasonic: All units and all firmwares.

P. The VMS shall allow for the configuration of a time zone for each camera connected to a DVS. For playback review, users shall have the ability to search for video based on the following options:

1. Local time of the camera
2. Local time of the SSM
3. Local time of user's workstation
4. GMT Time
5. Other time zone

Q. Audio and Video storage configuration for the SSM shall either be:

1. Internal or external IDE/SATA/SAS organized or not in a RAID configuration.
2. Internal or external SCSI/iSCSI/Fiber Channel organized or not in a RAID configuration.
3. Within the overall storage system, it shall be possible to include disks located on:

a. External PCs on a LAN or WAN
b. Network Attached Servers (NAS) on a LAN or WAN
c. Storage Area Networks (SAN)

R. The SSM shall not limit the actual storage capacity configured per server.

S. Manufacturer:

1. Genetec Security Center:

a. Omnicast Enterprise

2.3 CYBER SECURITY REQUIREMENTS

A. The USP shall be an IP enabled solution. All communication between the SSM and CSA shall be based on standard TCP/IP protocol and shall use TLS encryption with digital certificates to secure the communication channel.

B. The USP shall support user authentication with claims-based authentication using external providers. External providers shall include:

1. ADFS (Active Directory Federation Services)
2. Azure Active Directory (through OpenID Connect)
3. Ping Identity (through OpenID Connect)
4. KeyCloak (through OpenID Connect)
5. Other Open ID Connect / SAML2 authentication agents

C. The USP shall limit the IP ports in use and shall provide the Administrator with the ability to configure these ports.

D. The VMS shall support only secured media stream requests, unless explicitly configured otherwise. Secured media stream requests shall be secured with strong certificate based authentication leveraging RTSPS (RTSP over TLS). Client authentication for media stream requests is claims-based and may use a limited lifetime security token.

E. The VMS shall offer the ability to encrypt the media stream, including video, audio, and metadata with authenticated encryption. Media stream encryption shall be done at rest and in transit and be a certificate based AES 128-bits encryption. The VMS shall:

1. Allow encryption to be set on a per camera basis for all or some of the cameras.
2. Provide up to 20 different certificates for different groups of CSA or users who have been granted access to decrypted streams.
3. Not decrease the recording performance by more than 50% when encryption is enabled.
4. Use Secure RTP (SRTP) to encrypt the payload of a media stream in transit and allow multicast and unicast of the encrypted stream.
5. Use a random encryption key and change periodically.
6. Allow encrypted streams to be exported.

F. The VMS shall support end to end encrypted streams with cameras supporting Secure RTP (SRTP) both in unicast and multicast from the camera.

G. The USP shall support encryption for all communications with its databases.

H. The USP shall provide in its main user interface a visual list showing the state of all configuration items relating to the cyber security hardening of the features of the system.

I. The USP shall provide recommendations relating to the passwords used to access the hardware units in the system. The recommendation should display if the passwords used on the units are weak, average, strong, or very strong.

J. The USP shall provide the ability to manually or automatically change the video unit passwords with manufacturer's native API, standard Genetec Protocol or ONVIF. The VMS shall support password change for video units as follows:

1. In batch or per unit
2. On schedule
3. From an event
4. Based on manufacturer's policies
5. The USP shall allow backup of last 5 passwords.
6. The USP shall allow copying password to clipboard to be used in the device webpage if the user has the appropriate privileges.
7. The USP shall provide the ability to export the video unit passwords if the user has the appropriate privileges.

K. The USP shall provide recommendations relating to the firmware of the hardware units enrolled in the system. Recommendations should display if the firmware is up to date, out of date, or if it has known security vulnerabilities.

2.4 FAILOVER AND STANDBY REQUIREMENTS

A. The USP shall support native and off-the-shelf failover options.

B. Failover Directory:

1. The Standby Directory shall act as a replacement SSM on hot standby, ready to take over as the acting Directory in case the primary Directory fails. The failover shall occur in less than one minute. No action from the user shall be required.
2. The USP shall support up to five (5) Directories on standby, lined up to take over as the acting Directory in a cascading fashion.
3. The Standby Directory shall keep its configuration database synchronized with the primary Directory.
4. The Standby Directory shall support disaster recovery scenarios where a server can be located in another geographic area (or building) and only take over if all other Directories become offline.
5. The Standby Directory shall support synchronization of the configuration databases using a backup and restore mechanism. The synchronization period shall be configurable from 15 minutes to 1 week.
6. The Standby Directory shall support real-time synchronization of the configuration databases using SQL Mirroring or SQL Always On.

C. Standby Archiver. Refer to section 2.05 Standby Archiver for more information.

D. Off-the-shelf standby/failover options (excluding the VMS Archiver) shall include:

1. Windows Clustering
2. NEC ExpressCluster X LAN

2.5 ARCHIVING

A. The Archiver (role) shall use an event and timestamp database for the advanced search of audio/video archives. This database shall use Microsoft SQL.

B. The Archiver shall protect archived audio/video files and the system database against network access and non-administrative user access.

C. The Archiver shall digitally sign recorded video using an EdDSA signature algorithm based on a public/private key cryptography.

D. The Archiver shall offer a plug and play type hardware discovery service with the following functionalities:

1. Automatically discover DVS units as they are attached to the network.
2. Discover DVS units on different network segments, including the Internet, and across routers with or without network address translation (NAT) capabilities.

E. The Archiver shall have the capacity to configure the key frame interval (I-frame) in seconds or number of frames.

F. The Archiver shall provide a pre-alarm and post-alarm recording option that can be set between one second and 5 minutes on a per camera basis.

G. The Archiver shall provide the functionality of storing of video and audio streams based on triggering events, such as:

1. Digital motion detection
2. Digital input activation
3. Macros
4. Through SDK application recording

H. The Archiver shall perform video motion detection on each individual camera based on a grid of 1320 motion detection blocks. All of the video motion detection settings are configurable on schedule. A global sensitivity threshold is available to reduce motion detection sensitivity when the video signal is noisy or when a lot of false hits are incurred. Video motion detection itself can be set into four different modes:

1. Full Screen: All 1320 blocks on screen are activated, and a general threshold for the overall motion in the entire image can be set, and when it is reached, it can trigger recording and a motion event or a custom event.
2. Full Screen Unit: This is the same as the Full Screen but the motion detection takes place in the DVS.
3. Detection Zone: Six overlapping zones can be defined in the 1320 blocks on screen with each of these zones having its own threshold, and, when that threshold is reached, each one of them can trigger recording and a motion event or a custom event. Each zone triggering its own event allows for the configuration of directional motion detection events and other complex motion detection logic.
4. Detection Zone Unit: This is the same as the Detection Zone, but the motion detection takes place in the DVS and only one zone is supported.
5. Disabled: No motion detection is performed on this camera.

I. The Archiver shall be able to detect motion in video within 200 milliseconds and not only on key frames.

J. The Archiver shall allow for multiple recording schedules to be assigned to a single camera. Each schedule shall be created with the following parameters:

1. Recording mode:

    a. Continuous
    b. On Motion/Manual
    c. Manual
    d. Disabled

2. Recurrence pattern:

    a. Once on specific days
    b. Specific days on a yearly basis
    c. Specific days on a monthly basis
    d. Specific days on a weekly basis
    e. Daily
    f. Time coverage:
    g. All day.
    h. Specific time range(s).
    i. Daytime or nighttime based on the times of sunrise and sunset that are automatically calculated from the time of year and a geographical location. Provision shall be given to offset the calculated sunrise or sunset time by plus or minus 3 hours.

K. The Archiver shall allow each camera (video source) to be encoded multiple times in the same or different video formats (H.265, H.264, MPEG-4, MPEG-2, MJPEG, MxPEG, Wavelet, or JPEG2000), limited only by the capabilities of each DVS.

L. Whenever multiple video streams are available from the same camera, users shall be free to use any one of them based on their assigned usage. The standard video stream usages are:

1. Live
2. Recording
3. Remote
4. Low resolution
5. High resolution

M. The Archiver shall allow the video quality to vary according to predefined schedules. Such schedules shall have the same configuration flexibility as the recording schedules mentioned earlier. The video quality shall be based on, but not limited to, the following parameters:

1. Maximum bit rate
2. Maximum frame rate
3. Image quality
4. Key frame interval

N. The Archiver shall have the ability to dynamically boost the quality of the "recording stream" (see previous bullet) based on specific events:

1. When recording is started manually by a user.
2. When recording is triggered by a macro, an alarm or detected motion.

O. The Archiver shall have the capacity to communicate with the DVS using 128 bits SSL encryption.

P. The Archiver shall have the capacity to communicate with the DVS using HTTPS secure protocol.

Q. The Archiver shall have the capacity to receive multicast UDP streams directly from the DVS.

R. For network topologies that restrict the DVS from sending multicast UDP streams, the Archiver shall redirect audio/video streams to active viewing clients on the network using multicast UDP.

S. The Archiver shall have the capacity to redirect audio/video streams to active viewing clients on the network using unicast UDP or TCP.

T. The Archiver shall empower the administrator with a full range of disk management options:

1. The Archiver shall allow the administrator to choose which disks to use for archiving and to set a maximum quota for each.
2. The Archiver shall allow the administrator to spread the archiving of different cameras on different disk groups (groups of disks controlled by the same controller) so that archiving could be carried out in parallel on multiple disks.
3. The Archiver shall have the capacity to move video archives to the Azure Cloud. The archives will be moved after a preset number of days.

U. The Archiver shall empower the administrator with a full range of archive management options:

1. The Archiver shall provide a graphical representation of video sequences and recording gaps.
2. The Archiver shall provide a way to identify the location of the video sequences.

V. The Archiver shall offer the following options to clean up old archives, on a camera by camera basis:

1. After a preset number of days.
2. Deleting oldest archives first when disks run out of space.
3. Stop archiving when disks are full.

W. The Archiver shall allow important video sequences to be protected against normal disk cleanup routines.

X. Users shall have the following options when protecting a video sequence:

1. Until a specified date
2. For a specified number of days
3. Indefinitely (until the protection is explicitly removed)

Y. The Archiver shall allow the administrator to put a cap on the percentage of storage space occupied by protected video.

Z. The Archiver shall keep a log and compile statistics on disk space usage.

1. The statistics shall be available by disk group or for the whole Archiver.
2. The statistics shall show the percentage of protected video over the total used disk space.

AA. The Archiver shall have the capacity to down-sample video streams for storage saving purposes. The down-sampling options available are the following:

1. For H.264, MPEG-4, and H.265, streams the down-sampling options are: all key frames, 1 fps, 2 sec./frame, 5 sec./frame, 10 sec./frame, 15 sec./frame, 30 sec./frame, 60 sec./frame, 120 sec./frame.
2. For MJPEG streams the down-sampling options are: 15 fps, 10 fps, 5 fps, 2 fps, 1 fps, 2 sec./frame, 5 sec./frame, 10 sec./frame, 15 sec./frame, 30 sec./frame, 60 sec./frame, 120 sec./frame.

BB. The Archiver shall support DVS with edge recording capabilities and offer the following capacity:

1. The ability to playback the video recorded on the DVS at different speeds.
2. The ability to offload (video trickling) the video recorded on the DVS on schedule, on event, or manually to store it on the Archiver.
3. It shall be possible to filter the video that is being offloaded using one or multiple of the following filters:

    a. Time interval
    b. Playback request
    c. Video analytic events
    d. Motion events
    e. Bookmarks
    f. Alarms
    g. Input pin events

h. Unit offline events

CC. The Archiver shall be provided with proven performance and scalability figures:

1. The Archiver's performance shall be guaranteed during the rebuild of a disk from a raid 5 disk group. The rebuild process shall not affect the recording and playback capabilities.
2. The recommended server specification from the Genetec Security Center Hardware Requirement shall allow Archiver to perform up to 300 cameras or 300Mbs throughput first limit reached.
3. The high-performance archiver specification from the Genetec Security Center Hardware Requirement shall allow Archiver to perform:

a. Up to 500 cameras or 500Mbs throughput first limit reached with a 1Gbps NIC.

DD. The Archiver shall provide the ability to encrypt the media stream coming from the DVS including the video, audio and metadata:

1. Media encryption shall be optional and can be activated on a per DVS basis.
2. Media encryption shall be performed with AES 128-bits.
3. Media encryption shall encrypt all video, audio and metadata at rest and in transit. Once media encryption is turned on for a DVS all media stored or redirected by the Archiver shall be encrypted and shall require the private key to be decoded.
4. It shall be possible to export the encrypted media into a non-encrypted ASF file.

2.6 AUXILIARY ARCHIVER

A. The Auxiliary Archiver shall be used to produce redundant archives (video, events, or bookmarks) for any camera in the system, on a case by case basis.

B. The Auxiliary Archiver shall have the ability to record a camera on a different schedule than the Archiver.

C. The Auxiliary Archiver shall have the ability to archive any of the standard video streams for archiving. The standard video stream usages are: Live, Recording, Remote, Low Resolution, and High Resolution.

D. The Auxiliary archiver shall have the capacity to move video archives to the Azure Cloud.

2.7 STANDBY ARCHIVER

A. The Standby Archiver shall act as a replacement Archiver role on hot standby, ready to take over the functions of the primary Archiver role. The failover will occur in less than 1 minute. No action from the user will be required.

B. The Standby Archiver assigned to an Archiver role entity shall automatically provide protection for all DVS connected to that Archiver role.

C. The Standby Archiver shall protect the primary Archiver role against the following failures:

1. Server failure (hardware or software).

2. Storage failure, such as Archiver Role detects that it cannot read or write to any of its allocated disks.

D. It shall be possible for a single USP server to act as the standby server of multiple Archiver roles.

1. Each Archiver role shall have priority value if multiple Archiver Roles fail at the same time on the same standby server.

E. It shall be possible for any Archiver role in the system to be designated as another's standby and vice-versa.

F. For each Archiver role it shall be possible to set up to 2 standby Archiver so that if the first failover Archiver fails the failover will automatically occur to a third server.

G. The Standby Archiver shall have the ability to act as a Redundant Archiver.

H. It shall be possible to set a different retention period for the Archiver and the Redundant Archiver.

I. The Redundant Archiver shall maintain an exact copy of everything recorded by the default Archiver, i.e. audio/video archives, events, and bookmarks.

J. Redundancy shall be configured on a camera by camera basis.

K. The Redundant Archiver shall have to ability to use a multicast video stream from the DVS and shall not require an additional connection to any DVS.

2.8 CLOUD ARCHIVING

A. The VMS shall support the automatic transfer of video recorded on the Archiver to the cloud, based on the age of the video.

B. The Archiver shall encrypt recordings using AES-256 prior to transferring video to the cloud.

C. The Archiver shall rotate the encryption key at every file. The encryption key shall be encrypted with a certificate kept in Azure Key Vault.

D. The VMS shall support TLS encryption between the on-premises Archiver and the cloud.

E. The VMS shall allow users to search video stored in the cloud through the same functionality used when querying video that is stored locally.

F. The VMS will maintain a local cache of video downloaded from the cloud, to playback recordings without requiring an additional transfer.

G. The VMS shall support different tiers to support the video sequences.

1. The VSM shall allow users to differentiate the video sequences available for real-time and delayed retrieval.
2. The VMS shall automatically move video sequences from the real-time access to delayed retrieval after a configurable delay.

2.9 VMS MEDIA STREAMING

A. The Media Router Role shall be responsible for routing video and audio streams across local and wide area networks from the source (for example DVS) to the destination (for example CSA).

B. The Media Router Role shall support multiple transport protocols, such as unicast TCP, unicast UDP, and multicast UDP.

C. The Media Router shall support IGMP (Internet Group Management Protocol) to establish multicast group memberships:

1. IGMP v3, including SSM (Source-Specific Multicast) shall be supported.

D. The Media Router Role using Redirector Agents shall be responsible for redirecting a stream from a source IP endpoint to a destination IP endpoint.

E. The Redirector Agents shall be capable of converting a stream from and to any supported transport protocols:

1. Multicast UDP to Unicast TCP
2. Multicast UDP to Unicast UDP
3. Unicast TCP to Multicast UDP
4. Unicast UDP to Multicast UDP

F. It shall be possible to limit the number of concurrent live and playback video redirections for each Redirector Agent in order to better control the bandwidth across multiple sites.

G. It shall be possible to limit the bandwidth consumed by live and playback video from the CSA to better control the bandwidth across multiple sites. The SSM shall be able to prioritize video streaming to the CSA based on user level.

H. It shall be possible to protect the Media Router Role against hardware or software unavailability by configuring another Media Router Role to act as a hot standby server.

I. Multiple Redirector Agents shall be used on a large VMS installation to increase the service availability and to provide automatic load balancing.

2.10 VMS VIDEO ARCHIVES TRANSFER CAPABILITIES

A. Archive transfer shall provide the ability to:

1. Transfer video from a server to another server in the same system.
2. Transfer video from a federated server to another server.
3. Transfer video from camera storage to a server.

B. It shall be possible to program video transfers either on a recurrent schedule, or to trigger them manually or upon connection.

C. It shall be possible to filter the video of interest for a transfer. The video of interest shall be defined with the following filters:

1. All archives when the camera was offline.

2. Alarms.
3. Playback request from the edge.
4. Video analytics events.
5. Motion events.
6. Bookmarks.
7. Input triggers.
8. Time range.

D. It shall be possible to define the length of video before and after the event used as a filter to determine the video of interest.

E. The USP shall offer an interface for displaying all video archive transfer requests. This interface shall display all the current, requested and scheduled video transfer requests. It shall be possible to edit, trigger, and cancel video archive transfers from this interface.

F. The USP shall offer an interface for querying past video transfers and their outcome.

2.11 SECURITY VIDEO ANALYTICS

A. The analytics shall be completely unified with the Video Management System.

B. Configuration shall natively be performed in the configuration interface of the Video Management System.

C. The analytics shall feature dedicated configuration possibilities for the following scenarios:

1. Perimeter protection
2. Area protection
3. Direction control
4. Object detection
5. Stopped vehicle detection
6. Tailgating Detection

D. Each of the scenarios shall trigger events in the Video Management System, which correspond to their functionality.

E. Additional to these scenarios, the analytics shall allow to configure custom intrusion detection and object detection scenarios as well as allow to import settings to allow maximum flexibility.

F. The analytics license shall allow to configure any one of these scenarios per camera.

G. The analytics shall allow at least two different detection variants:

a. Trigger an alarm if a motion pattern moves from zone A (source) through zone B into zone C (sink).
b. Trigger an alarm if a motion pattern moves anywhere inside a specified zone.

H. The analytics shall support an unlimited number of detection areas.

I. The analytics feature rain-filters to filter out disturbances.

J. The analytics shall feature live configuration to immediately see the effects of parameter changes in the configuration interface without prior saving new configurations.

K. The configuration of the analytics shall be possible on recorded video streams.

L. The analytics shall offer the possibility to configure object movement paths.

M. The analytics shall not employ tripwires or cross-lines.

N. Areas and the scenes perspective (near & far object size) shall be configured on-screen using a point-and-click interface.

O. The analytics shall feature filters for movement speed, distance, and direction to detect events.

P. The analytics shall feature options to separately show or hide areas, area names, and detection overlays.

Q. The analytics shall be fully server-based, with no calculation on cameras necessary.

R. The analytics shall operate with color, thermal, and infrared cameras.

S. The accuracy of the analytics shall be evaluated and approved by the CPNI Video Analytics Assessment Programme and shall be listed in the CPNI Catalogue of Security Equipment (CSE).

2.12 CAMERA INTEGRITY MONITOR

A. Description:

1. Automatically checks camera feeds to detect if cameras have been tampered with.
2. Can be used for near-real-time alerting of tampering events or as a maintenance tool.
3. Reports can be run on detected tampering events.

B. Details:

1. It shall be completely unified with the Video Management System.
2. It shall be possible to set the detection sensitivity per camera stream between low, medium, and high.
3. It shall be possible to choose on which servers the analytics shall run.
4. The camera stream used for analytics shall be configurable.
5. It shall be possible to define how many cameras are being analyzed at the same time.
6. To utilize minimum hardware resources, it shall be definable how often camera streams are analyzed.
7. There shall be an overview over which cameras are configured to be analyzed.

2.13 PRIVACY PROTECTOR

A. Description:

1. Automatically obscures all movement in surveillance videos in real-time.

2. Live privacy masking of moving objects (such as people and vehicles).
3. Completely unified with the video management system.
4. Native configuration in the configuration interface of the video management system.

B. Details:

1. Certified with a valid EuroPriSe certification seal.
2. Privacy masking can be removed either per camera or for all cameras currently viewed. Masking for all cameras viewed can be removed and added either manually with a button or automatically with an action.
3. Indoor / outdoor modes using flexible background modeling:

    a. Indoor: Learning model with up to 10 different illumination states – this allows to adapt to fast lighting changes such as lights switching on and off.
    b. Outdoor: Foreground detection based on edge detection rather than color – this allows to adapt to heavily changing lighting conditions such as clouds temporarily blocking sunlight.

4. Detects movements using an absolute difference image, calculated by subtracting the current frame from a calculated background model.
5. Masks movements using blocks, thus obscuring the outline of an object or person.
6. Three different scrambling methods: Pixelation, Colorize, and Transparency.
7. Masking grids can be configured in a point-and-click interface.
8. Past preview mode to see configuration changes in the configuration interface without necessity to save the configuration.
9. Zones can be freely definable polygons with a point-and-click interface.
10. Option to set analysis resolution to optimize performance.
11. No calculation on the camera necessary, completely server-based.
12. Option to define zones, which should always or never be pixelated.
13. Option to choose input stream and output stream parameters, including resolutions, frame rate, and encoding.
14. Utilizes server-side hardware acceleration to maximize the amount of cameras analyzed per server.

2.14 PEOPLE COUNTER

A. Description:

1. Automatically counts people in a camera's field of view.
2. Provides live dashboard widgets dedicated for people counting.
3. Completely unified in the video management system.
4. Native configuration in the configuration interface of the video management system.

B. Details:

1. Based on deep-learning models trained on person detection to exclude non-human objects.
2. Dedicated dashboard widgets for people counting with the following features:

a. Charts: visualization of counts in line- or bar-charts
b. Throughput: Show number of persons in given time-frame.
c. Occupancy: Show how many people are in an area (IN minus OUT)

3. Counts adults and children.
4. Counts persons in wheel-chairs.
5. Supports top-down camera views.
6. Supports bi-directional counting.
7. Supports tilted camera views.
8. Option to show/hide overlays with detected persons and counting line.
9. No GPU required to run.
10. The occupancy widget support resetting the count at a defined time option to define zones, which should always or never be pixelated.
11. Supports organizing cameras into areas and show these areas in widgets.
12. Utilizes server-side hardware acceleration to maximize the amount of cameras analyzed per server.
13. Counts can be integrated to external systems using CSV exports and a .NET SDK

2.15 GENERAL CLIENT SOFTWARE REQUIREMENTS

A. The Client Software Applications (CSA) shall provide the user interface for USP configuration and monitoring over any network and be accessible locally or from a remote connection.

B. The CSA shall consist of the Configuration UI for system configuration and the Monitoring UI for monitoring. The CSA shall be Windows-based and provide an easy-to-use graphical user interface (UI).

C. The CSA for monitoring shall support running in 64-bit mode.

D. The Server Administrator shall be used to configure the server database(s). It shall be web-based and accessible locally on the SSM or across the network.

E. The CSA shall seamlessly merge access control, license plate recognition (ALPR), and video functionalities within the same user application.

F. The USP shall use the latest user interface (UI) development and programming technologies such as Microsoft WPF (Windows Presentation Foundation), the XAML markup language, and the .NET software framework.

G. All applications shall provide an authentication mechanism, which verifies the validity of the user. As such, the administrator (who has all rights and privileges) can define specific access rights and privileges for each user in the system.

H. Logging on to a CSA shall be done either through locally stored USP user accounts and passwords or using the operator's Windows credentials when Active Directory integration is enabled.

I. When integrated with Microsoft's Active Directory, the CSA and USP shall authenticate users using their Windows credentials. As a result, the USP will benefit from Active Directory password authentication and strong security features.

J. When integrated with an external identity provider such as Windows Active Directory, ADFS (Active Directory Federation Services) or an Open ID Connect/SAML2 identity provider (ex.: Azure AD), the CSA and USP shall authenticate using a Single-Sign On experience to the users. As a result, the USP will benefit from reusing the same credential throughout enterprise applications.

K. The CSA shall support multiple languages, including but not limited to the following: English, French, Arabic, Czech, Dutch, German, Hebrew, Hungarian, Italian, Japanese, Korean, Norwegian, Persian (Farsi), Polish, Portuguese (Brazilian), Simplified and Traditional Chinese, Russian, Spanish, Swedish, Thai, Turkish, and Vietnamese.

L. To enhance usability and operator efficiency, the Configuration UI and Monitoring UI shall support many of the latest UI such as:

1. A customizable Home Page that includes favorite and recently used tasks.
2. Task-oriented approach for administrator/operator activities where each type of activity (surveillance, visitor management, individual reports, and more) is an operator task.
3. Consolidated and consistent workflows for video, ALPR, and access control.
4. Single click functionality for reporting and tracking. The Monitoring UI shall support both single-click reporting for access control, ALPR, and video, as well as single-click tracking of areas, cameras, doors, zones, cardholders, elevators, ALPR entities, and more. Single-click reporting or tracking shall create a new task with the selected entities to report on or track.

M. Configuration UI and Monitoring UI Home Page and Tasks

1. The Configuration UI and Monitoring UI shall be task-oriented.
2. A task shall be user interface design patterns whose goal is to simplify the user interface by grouping related features from different systems, such as video and access, in the same display window. Features shall be grouped together in a task based on their shared ability to help the user perform a specific task.
3. Tasks shall be accessible via the Home Page of either the Configuration or the Surveillance CSA.
4. Newly created tasks shall be accessible via the Configuration UI or the Monitoring UI taskbar.
5. Similar tasks shall be grouped into the following categories:

    a. Operation: Access control management, LRP management, and more.
    b. Investigation: Video bookmark/motion/archive reports, access control activity reports, visitor activity reports, alarm reports, ALPR activity reports, and more.
    c. Maintenance: Access control and video configuration reports, troubleshooters, audit trails, health-related reports, and more.

6. An operator shall be able to launch a specific task only if they have the appropriate privileges.
7. The Home Page content shall be customizable through the use of privileges to hide tasks that an operator should not have access to and through a list of favorite and recently used tasks. In addition, editing a USP XML file to add new tasks on the fly shall also be possible.

N. The Contractor shall provide up to (see plans) number of simultaneous Clients.

2.16 CONFIGURATION USER INTERFACE (UI)

A. General:

1. The Configuration UI application shall allow the administrator or users with appropriate privileges to change the system configuration. The Configuration UI shall provide decentralized configuration and administration of the USP system from anywhere on the IP network.
2. The configuration of all embedded ACS, VMS, and ALPR systems shall be accessible via the Configuration UI.
3. The Configuration UI shall have a home page with single-click access to various tasks.
4. The Configuration UI shall include a variety of tools such as troubleshooting utilities, import tools, and a unit discover tool, amongst many more.
5. The Configuration UI shall include a static reporting interface to:

    a. View historical events based on entity activity. The user shall be able to perform such actions as printing a report and troubleshooting a specific access event from the reporting view.
    b. View audit trails that show a history of user/administrator changes to an entity.

6. Common entities such as users, schedules, alarms and many more, can be reused by all embedded systems (ACS, VMS, and ALPR).

B. Video management system:

1. The Configuration UI shall allow the administrator or users with appropriate privileges to change video configuration.
2. The Configuration UI shall provide the ability to change video quality, bandwidth, and frame rate parameters on a per camera (stream) basis for both live and recorded video.
3. The Configuration UI shall provide the ability to change video quality by a selection of predefined video quality template.
4. The Configuration UI shall provide the ability to configure brightness, contrast, and hue settings for each camera on the same DVS.
5. The Configuration UI shall provide the capability to enable audio recording on DVS units that support audio.
6. The Configuration UI shall provide the ability to change the audio parameters, serial port and I/O configuration of individual DVS units.
7. The Configuration UI shall provide the capability to rename all DVS units based on system topology and to add descriptive information to each DVS.
8. The Configuration UI shall provide the ability to set recording schedules and modes for each individual camera. The recording mode can be:

    a. Continuous
    b. On motion and Manual
    c. Manual only
    d. Disabled

9. The Configuration UI shall support the creation of schedules to which any of the following functional aspects can be attached:

    a. Video quality (for each video stream per camera)

b. Recording (for each camera)
c. Motion detection (for each detection zone per camera)
d. Brightness, Contrast, and Hue (for each camera)
e. Camera sequence execution

10. The Configuration UI shall support the creation of unlimited recording schedules and the assigning of any camera to any schedule.
11. The Configuration UI shall detect and warn user of any conflict within assigned schedules.
12. The Configuration UI shall provide the capability to set a PTZ protocol to a specific DVS serial port and shall allow mixing domes of various manufacturers within a system.
13. User shall have the ability to configure a return to home function after a predefined time of inactivity for PTZ cameras. This period of inactivity time shall be configurable from 1 to 7200 seconds.

2.17 VMS CLIENT USER INTERFACE (UI)

A. The Monitoring UI shall fulfill the role of a Unified Security Interface that is able to monitor video, ALPR, and access control events and alarms, as well as view live and recorded video.

B. The Monitoring UI shall provide a graphical user interface to control and monitor the USP over any IP network. It shall allow administrators and operators with appropriate privileges to monitor their unified security platform, run reports, and manage alarms.

C. To enhance usability and operator efficiency, the Monitoring UI shall support the following UI concepts:

1. Dynamically adaptive interface that adjusts in real-time to what the operator is doing.
2. A dynamic controls section loaded with entity-specific widgets (e.g. door and camera widgets).
3. Use of transparent overlays that can display multiple types of data in a seamless fashion.
4. Display tile menus and quick commands.
5. Consolidated and consistent workflows.
6. Tile menus and quick commands easily accessible within every display tile of the user workspace.
7. Single click functionality for reporting and tracking. The Monitoring UI shall support both single-click reporting for access control, ALPR, and video, as well as single-click tracking of areas, cameras, doors, zones, cardholders, elevators, ALPR entities, and more. Single-click reporting or tracking shall create a new task with the selected entities to report on or to track.

D. Monitoring UI Home Page and Tasks:

1. Similar tasks shall be grouped into the following categories:

a. Operation: Access control/LRP/video surveillance, visitor management, mustering, access control and video alarm monitoring, and more.
b. Investigation: Video bookmark/motion/archive reports, access control activity reports, visitor activity reports, alarm reports, ALPR activity reports, and more.
c. Maintenance: Access control and video configuration reports, troubleshooters, audit trails, and more.

E. Dynamically Adaptive UI, Controls section, and Widgets:

1. The Monitoring UI shall dynamically adapt to what the operator is doing. This shall be accomplished through the concept of widgets that are grouped in the Monitoring UI Controls section.
2. Widgets shall be mini-applications or mini-groupings in the Monitoring UI Controls section that let the operator perform common tasks and provide them with fast access to information and actions.
3. With a single click on an entity (for example door or camera) the specific widgets associated to that entity appear and other non-relevant widgets disappear dynamically (instantly). Widgets shall bring the operator information such as door status and camera stream information, as well as user actions, such as door unlock, PTZ controls, and more.
4. Specific widgets include those for a door, camera, alarm, zone, display tile, video stream (statistics), PTZ camera, and more.

F. Operator Workflows:

1. A workflow shall be a sequence of operations an operator or administrator shall execute to complete an activity. The “flow” relates to a clearly defined timeline or sequence for executing the activity.
2. The Monitoring UI shall be equipped with consistent workflows for the ALPR, video, and access control systems that it unifies.
3. Generating or printing a report, setting up or acknowledging an alarm, or creating an incident report shall follow the same process (workflow) whether the operator is working with video, ALPR, or access control, or with both video and access control.

G. Each task within the Monitoring UI shall consist of one or more of the following items:

1. Event list.
2. Logical tree: Doors, cameras, zones, ALPR units, and elevators shall be grouped under Areas in a hierarchical fashion.
3. Entities list of all entities being tracked.
4. Display tiles with various patterns (1 x 1, 2 x 2, and more).
5. Display tile menu with various commands related to cameras, doors, PTZ, and tile controls.
6. Controls section with widgets.

H. The Monitoring UI shall support multiple event lists and display tile patterns, including:

1. Event/alarm list layout only
2. Display tile layout only
3. Display tile and alarm/event list combination
4. ALPR map and alarm/event list combination

I. User workspace customization

1. The user shall have full control over the user workspace through a variety of user-selectable customization options. Administrators shall also be able to limit what users and operators can modify in their workspace through privileges.
2. Once customized, the user shall be able to save his or her workspace.
3. The user workspace shall be accessible by a specific user from any client application on the network.

4. Display tile patterns shall be customizable.
5. Event or alarm lists shall span anywhere from a portion of the screen up to the entire screen and shall be resizable by the user. The length of event or alarm lists shall be user-defined. Scroll bars shall enable the user to navigate through lengthy lists of events and alarms.
6. The Monitoring UI shall support multiple display tile patterns (for example one display tile (1x1 matrix), 16 tiles (8x8 matrix), and multiple additional variations).
7. The Monitoring UI shall support as many monitors as the PC video adapters and Windows Operating System are capable of accepting.
8. Additional customization options include show/hide window panes, show/hide menus/toolbars, show/hide overlaid information on video, resize different window panes, and choice of tile display pattern on a per task basis.

J. The Monitoring UI shall provide an interface to support the following tasks and activities common to access control, ALPR, and video:

1. Monitoring the events from a live security system (ACS and/or VMS and/or ALPR).
2. Generating reports, including custom reports.
3. Monitoring and acknowledging alarms.
4. Creating and editing incidents and generating incident reports.
5. Displaying dynamic graphical maps and floor plans as well as executing actions from dynamic graphical maps and floor plans.
6. Management and execution of hot actions and macros.

K. The Monitoring UI shall be able to monitor the activity of the following entities in real-time: areas, ALPR entities, doors, elevators, cameras, cardholders, cardholder groups, zones (input points), and more.

L. The Monitoring UI shall include advanced video capabilities, including:

1. Advanced live video viewing functionality.
2. Advanced archive playing and video playback functionality.
3. Monitoring and management of video system events and alarms.
4. Intercom or duplex audio.
5. Generation of video reports.
6. Control of PTZ cameras.
7. Creating and monitoring archive transfer requests.
8. Display metadata overlaid on live or playback video.

M. The Monitoring UI shall leverage the Graphical Processing Unit (GPU) for video decoding.

1. The following GPU technologies shall be supported:

   a. NVidia CUDA
   b. Intel Quick Sync

2. The Monitoring UI shall have the ability to decode video through the optimal simultaneous use of the GPU and Computer Processing Units (CPU).

N. The live video viewing capabilities of the Monitoring UI shall include:

1. The ability to display all cameras attached to the USP and all cameras attached to federated systems.
2. Support for live video monitoring on each and every display tile within a task in the user's workspace.
3. The USP shall support uninterrupted video streaming. The CSA shall keep existing video connections active in the event that an SSM (except Archiver) becomes unavailable.
4. The ability to drag and drop a camera into a display tile for live viewing.
5. The ability to drag and drop a camera into a display tile for live viewing on an analog monitor connected to an IP hardware decoder (converting an IP encoded stream into an analog video signal).
6. The ability to drag and drop a camera from a map into a display tile for live viewing.
7. Support for digital zoom on live camera video streams.
8. The ability for audio communication with video units with audio input and output.
9. The ability to control pan-tilt-zoom, iris, focus, and presets.
10. The ability to bookmark important events for later retrieval on any archiving camera and to uniquely name each bookmark in order to facilitate future searches.
11. The ability to start/stop recording on any camera in the system that is configured to allow manual recording by clicking on a single button.
12. The ability to activate or de-activate viewing of all system events as they occur.
13. The ability to switch to instant replay of the video for any archiving camera with the simple click of button.
14. The ability to take snapshots of live video and be able to save or print the snapshots.
15. The ability to view the same camera multiple times in different tiles.

O. The video playback (archive playing) capabilities of the Monitoring UI shall include:

1. Support for audio and video playback for any time span.
2. Support for video playback on each and every display tile.
3. The ability to instantly replay the video for any archiving camera with the simple click of a button.
4. The ability to select between instant synch of all video streams in playback mode, allowing operators to view events from multiple angles or across several camera fields, or non-synchronous playback.
5. The ability to simultaneously view the same camera in multiple tiles at different time intervals.
6. The ability to control playback with:

    a. Pause
    b. Lock Speed
    c. Forward and Reverse Playback at: 1x, 2x, 4x, 6x, 8x, 10x, 20x, 40x, 100x
    d. Forward and Reverse Playback frame by frame
    e. Slow Forward and Reverse Playback at: 1/8x, 1/4x, 1/3x, 1/2x
    f. Loop playback between two time markers

7. The ability to display a single timeline or one timeline for each selected video stream, which would allow the operator to navigate through the video sequence by simply clicking on any point in the timeline.
8. The ability to display the level of motion at any point on a timeline.
9. The ability to clearly display bookmarked events on the timeline(s).

10. The ability to query archived video using various search criteria, including, but not limited to, time, date, camera, and area.
11. The tool necessary for searching video and associated audio based on user-defined events or motion parameters.
12. The ability to define an area of the video field in which to search for motion as well as define the amount of motion that will trigger search results. The Monitoring UI shall then retrieve all archived video streams that contain motion that meets the search parameters. There shall be a graphical timeline on which the time of each search hit shall be indicated.
13. The ability to browse through a list of all bookmarks created on the system and select any bookmarked event for viewing.
14. The ability to add bookmarks to previously archived video for easier searching and retrieval.
15. Support for digital zoom on playback video streams.
16. Still image export to PNG, JPEG, GIF, and BMP format with Date and Time stamp, and Camera Name on the image (snapshot).
17. Tools for exporting video and a self-contained video player on various media such as USB keys or CD/DVD-ROM. This video player shall be easy to use without training and shall still support reviewing video metadata, such as bookmark, or navigating the video with functions like panoramic camera view dewarping.
18. Tools for exporting video sequences in standard video formats, such as ASF or MP4.
19. The ability to encrypt exported video files.
20. The ability for an operator to load previously exported video files from their computer or network.
21. The ability for queries to be saved upon closing the CSA and reappear when the application is reopened.
22. The ability to dynamically block, on demand, video stream dynamically to lower level users to prevent access, for a specific time, to live and recorded video.
23. A tool building and exporting a set of videos into a single container. This tool shall allow the operator to build sequences of video to create a storyboard and allow the export of synchronous cameras.
24. The ability to store the video export and still image export at a pre-defined storage location.
25. An interface with the ability to list, search, and manipulate previously generated video exports.
26. The ability to export sequences of video in open standards including ASF and MP4.

P. The Monitoring UI shall provide an interface to support the following ALPR tasks and capabilities:

1. Monitoring and management of ALPR events and alarms.
2. Viewing of license plate picture(s) and context images.
3. Viewing of license plate data (e.g. license plate reads)
4. Verification of ALPR data against live and recorded video.

Q. Entity Monitoring:

1. The USP shall permit the user to select multiple entities to monitor from the Monitoring UI by adding the entities one by one to the tracking list.
2. The Monitoring UI shall provide the option to filter which events shall be displayed in the display tile layout and/or event list layout.
3. It shall be possible to lock a Monitoring UI display tile so that it only tracks the activity of a specific entity (e.g. specific door or camera).

4. The user shall be able to drag and drop an event from an event list (or an alarm from an alarm list) onto a display tile to view a license plate read, cardholder picture ID, badge ID, or live/archived video, among other options.
5. Event, alarm, monitoring/tracking, and report lists shall contain cardholder pictures where applicable.
6. The user shall be permitted to start or pause the viewing of events within each display tile.

R. Display Tile Packing and Unpacking:

1. The Monitoring UI shall support single-click unpacking and packing for ALPR hits, ALPR reads, areas, doors, zones, camera sequences, and alarms.
2. The packing and unpacking of entities shall allow operators to quickly obtain additional information and camera views of a specific entity.
3. The unpacking of an entity shall display associated entities. For example, unpacking a door with multiple associated cameras shall display all cameras associated with that door. Unpacking shall reconfigure the display tiles to be able to display all associated entities. For example, unpacking a door (or a zone or alarm) that is currently in a 1 x 1 tile configuration and that has 3 cameras tied to it will create a 1 x 3 display tile arrangement for viewing all associated entities.
4. Packing will return the display to the original tile pattern.

S. Visual Tracking:

1. The Monitoring UI shall support the ability to manually track a moving target with the single click of a button.
2. The ability to switch from one camera view to an adjacent camera shall be done within a single display tile.
3. Switching between camera streams shall be accomplished by simply clicking on a semi-transparent shape or overlay.
4. Visual tracking shall be available with both live and recorded video.

2.18 SERVER ADMINISTRATOR USER INTERFACE REQUIREMENTS

A. The Server Administrator shall be used to configure the SSM and the Directory Role (main configuration) and its database(s), to apply the license, and more.
B. The Server Administrator shall be a web-based application. Through the Server Administrator, it shall be possible to access the SSM across the network or locally on the server.
C. Access to the Server Administrator shall be protected via login name, password, and encrypted communications.
D. The Server Administrator shall allow the administrator (user) to perform the following functions:

1. Manage the system license.
2. Configure the database(s) and database server for the Directory Role,
3. Activate/Deactivate the Directory Role.
4. Manually back up the Directory Role database(s) and/or restore the server database(s), as well as configure scheduled backups of the databases.
5. Define the client-to-server communications security settings.
6. Configure the network communications hardware, including connection addresses and ports.
7. Configure system SMTP settings (mail server and port).

8. Configure event and alarm history storage options.

2.19 UNIFIED WEB CLIENT (UWC) GENERAL REQUIREMENTS

A. The USP shall support a unified web client (UWC) for access control and video.
B. The UWC shall be a truly thin client with no download required other than an internet web browser or standard web browser plugins.
C. The UWC shall be platform independent and run within Microsoft Edge, Internet Explorer, Firefox, Safari, and Google Chrome.
D. Web pages for the web client shall be managed and pushed by the Web Server Role. Microsoft IIS or any other web hosting service shall not be required given that all the web pages shall be hosted by the Web Server Role.
E. The UWC shall support display on tablet format.
F. The UWC shall support native H.264 video in the web client.
G. Web pages for the web client shall be managed and pushed by the Web Client Server. Microsoft IIS or any other web hosting service shall not be required given that all the web pages shall be hosted by the Mobile Server.
H. The Contractor shall provide up to (SEE PLANS) number of simultaneous Web Clients.
I. The Web Client Server shall provide the ability to define a unique URL to access the web client, to ensure the security of the application.
J. The UWC shall provide the ability to load a camera layout.
K. The UWC shall provide the ability to configure, save, and reload private camera layouts.
L. The UWC shall provide the ability to control PTZ cameras.
M. Functionalities:

1. Log in support shall be available using:
    a. username and password
    b. Active Directory.
    c. Azure Active Directory, ADFS, OpenID Connect or SAML2 identity provider.
    d. Ability for user to change their password.

2. Encrypted communications for all transactions.
3. Print reports and export to CSV file.
4. Customer logo customization shall be available for multi-tenant and hosted services applications.
5. Video:

    a. Live and playback video at 320 x 240, 640 x 480 or 1280 x 1024 @ 15 fps
    b. Video export
    c. 1, 4, 6 or 9 tiles
    d. Basic PTZ Controls (Pan/Tilt, Zoom, go to presets, start pattern)
    e. Start / Stop recording
    f. Sample web page for customers to see how to view video for their own development
    g. Add bookmarks
6. Alarms:

    a. Alarm report

7. Threat Level.

2.20 SMARTPHONE AND TABLET APP GENERAL REQUIREMENTS

A. The USP shall support mobile apps for various off-the-shelf devices. The mobile apps shall communicate with the Mobile Server of the USP over any Wi-Fi or cellular network connection.

B. Mobile apps shall communicate with the USP via a Mobile Server Role (MSR). All communication between the mobile apps and MSR shall be based on standard TCP/IP protocol and shall use the TLS encryption with digital certificates to secure the communication channel.

C. Supported device manufacturers shall include (refer to Mobile App specifications for latest compatibility list):

1. Apple devices running iOS 11.0 or later
2. Android devices 6.0 or later

D. It shall be possible to download the mobile apps from the Central application store (Apple iTunes App Store, Google Play).

E. It shall be possible to push configuration to the mobile devices through a Mobile Device Management solution such as VMWare Workspace One or Microsoft Intune.

F. Functionalities:

3. Core
   a. Ability to logon/logoff to the USP using an authorized user profile of the system.
   b. Ability to support passive authentication from a single sign-on provider (OpenID Connect or SAML2 identity provider).
   c. Ability to use biometric features (thumbprint, face ID, etc.) to perform connection to the system.
   d. Ability to change the picture or the password of the user of the mobile app.
   e. Ability to view the current Threat Level of the system.
   f. Ability to change the current Threat Level of the system.
   g. Ability to execute hot actions configured in the user profile.
   h. Ability to view entities from the USP:

      i. Cameras
      ii. Doors
      iii. ALPR cameras
      iv. Web Tile Plugins
      v. Layouts
      vi. Camera Sequences
      vii. Macros
      viii. Maps (geographical maps only)

   i. Ability to navigate the system hierarchical view of the entities and search entities in the system.

4. Video

   a. Ability to view live and recorded video from the cameras of the USP. A maximum of four cameras shall be displayed.

b. Ability to view video in native format (H.264).
c. Ability to display live and recorded video side-by-side for a specific camera.
d. Ability to perform digital zoom on cameras.
e. Ability to perform actions on cameras such as add a bookmark, control a PTZ, control the iris/focus function, save a snapshot, start/stop recording.
f. Ability to view camera layouts.
g. Ability to view camera sequences.
h. Ability to run a camera events report.
i. Ability to change the video quality on the cameras displayed on the mobile app.
j. Ability to use the camera of the smartphone and stream a live video feed to a video recorder in the system.

5. Access Control

a. Ability to view the door state ad door lock state.
b. Ability to perform actions on a door such as unlock the door, set the door in maintenance mode, override the door unlocking schedule.

6. Automatic License Plate Recognition

a. Ability to view live events raised by an ALPR camera.
b. Ability to view the read image, context image, and all metadata captured by the ALPR camera.
c. Ability to run an ALPR event report.
d. Ability to add a license plate to a hotlist on the system.

7. Alarm Management

a. Ability to receive push notifications to notify mobile operators that an alarm was received.
b. Ability to view all active alarms assigned to the mobile operator.
c. Ability to perform action on an alarm such as acknowledge, forward, or alternate-acknowledge an active alarm.
d. Ability to view entities attached to the alarm.

8. Map

a. Ability to display a geographic map with USP entities geo-located on the map.
b. Ability to view any entity configured on the map.
c. Ability to search entities or location on the map.

B. It shall be possible to send a message from the client user interface to a mobile operator.
C. It shall be possible to send a live or playback video sequence from the client UI to a mobile operator.
D. It shall be possible to view mobile operators who enabled location tracking on a map in the system. The location of the mobile operator should be updated in real time.

2.21 HEALTH MONITOR

A. The USP shall monitor the health of the system, log health-related events, and calculate statistics.

B. USP services, roles, agents, units, and client apps will trigger health events.

C. The USP shall populate the Windows Event Log with health events related to USP roles, services, and client apps.

D. A dedicated role, the Health Monitoring Role, shall perform the following actions:

1. Monitor the health of the entire system and log events.
2. Calculate statistics within a specified time frame (hours, days, months).
3. Calculates availability for clients, servers and video/access/ALPR units.

E. A Health Monitoring task and Health History reporting task shall be available for live and historical reporting.

F. A Health Monitoring dashboard task shall be available in the client application user interface to provide a live display, such as pie charts and event lists, for quick visual assessment on the general health of the system.

G. A web-based, centralized health dashboard shall be available to remotely view unit and role health events of the USP.

H. Detailed system care statistics will be available through a web-based dashboard providing health metrics of USP entities and roles, including Uptime and mean-time-between-failures.

I. All health events raised in the system can be used for automating the USP event/action management.

J. Health events shall be accessible via the SDK (can be used to create SNMP traps).

Session Initiation Protocol (SIP) Communication Management (CM)

A. An operator of the USP shall be able to, within the USP Monitoring UI, initiate calls to and answer calls from other operator and edge voice devices such as intercoms, emergency call stations, information desks, softphones, or phone devices.

B. The USP shall support CM between the USP client User Interface and SIP endpoint devices.

C. SIP endpoints shall be able to register to the USP using a standard SIP protocol.

D. The USP shall support CM between two SIP endpoint devices.

E. The USP shall allow the configuration of SIP trunk connections to multiple SIP Servers supporting SIP Trunks.

F. The CM shall support the management of calls to and from other SIP Servers connected though SIP Trunks.

G. The USP shall support the configuration of paging zones for pre-recorded and live message announcements.

H. The CM is a service of the USP and shall not require the addition of any third party software.

I. The CM shall support the following video codecs:

1. H.264
2. H.263
3. H.263+ (1998)

J. The CM shall support the following audio codecs:

1. PCMA (G.711 aLaw)
2. PCMU (G.711 uLaw)
3. G.722
4. G.729
5. iLBC
6. GSM
7. telephone event
8. Speex (Narrowband)
9. Speex (Wideband)
10. Speex (Ultrawideband)
11. L.16
12. L.16-44-1
13. G.728
14. G.726-16
15. G.726-24
16. G.726-32
17. G.723
18. G.726-40

K. The CM shall certify SIP devices from the following manufacturers:

1. 2N Telekomunikace
2. Algo
3. Axis
4. Baudisch
5. Castel
6. Cisco
7. Code Blue
8. Commend
9. EMCOM
10. Grandstream networks
11. Jacques
12. Mobotix
13. Siedle
14. TalkaPhone
15. TOA Corporation
16. Valcom
17. Vingtor-Stentofon
18. Zenitel

19. Intelbras

L. The CM shall allow bidirectional audio and video recording of call sessions. The USP shall offer the following recording capabilities:

1. Automatic cleanup of call session files after a programmable number of days.
2. Deactivation of call recording between operators.
3. Deactivation of call recording with specific operators.
4. Deactivation of call recording with specific voice devices.
5. Selection of the storage path for call session recordings.

M. The CM shall provide the capability to reach a physical location identified by its own extension number regardless of the user connected to the USP.

N. The CM shall provide the flexibility for the administrator to define the network ports used to communicate between the USP servers and the following:

1. USP Operator Client User Interfaces
2. SIP devices
3. SIP servers

O. The CM shall provide the capability to create Ring Groups. A Ring Group is a group of call numbers grouped under a single call number. It shall be possible to set a Ring Group to simultaneously or sequentially call the members of the group. Dwell time for sequence mode shall be configurable.

P. The CM shall allow the automatic routing of calls through the configuration of a collection of rules (Dial Plan). Dial Plans shall support the following capabilities:

1. Match a phone number with regular expression.
2. Route calls based on matching the phone numbers from which calls are made.
3. Route calls based on matching the destination phone numbers to which calls are made.
4. Change the phone extension from which calls are received.
5. Change the phone extensions to which calls are sent.
6. A combination of any of the above capabilities in a configured priority and based on a schedule.

Q. Dial Plans shall be applicable to calls between SIP entities registered to the USP as well as to and from external SIP servers.

R. The USP shall unify, within a simple user interface, the workflow between the associated security entities of a call session, including the call box, cameras, doors, intrusion zones and outputs.

S. The USP shall support video and audio calls:

1. Between USP Client User Interfaces
2. To and from USP Client User Interfaces and SIP devices
3. Between SIP devices

T. The USP shall provide an advanced and friendly call management user interface that allows operators to:

1. Connect standard USB headsets and webcams to USP Client User Interface workstations so that USP users can make voice and video calls through the USP Client User Interface.
2. Display the video associated with the call and switch between multiple video sources.
3. Receive incoming call notifications directly through a notification tray.
4. Initiate, answer, forward, place on hold, or cancel calls from a dedicated call dialog box.
5. Control cameras, doors, zones, and device outputs during a call.
6. Create a customizable list of contacts, so that users can quickly call their contacts. Contact lists shall include other USP users, as well as SIP devices.
7. Dial a phone number to make a call.
8. Dial a DTMF sequence during a call.
9. Monitor the availability status of a user and set its own availability status.
10. Access a history log of calls that the operator both initiated and received. This log shall show the time of the call, duration, direction and the reason for its ending. It shall be possible to redial one of the entries in the log.

U. The USP shall allow an operator to manage up to 10 calls simultaneously. The call queue shall show the status of each call: incoming, in call, or on hold. It shall be possible to hold and resume a call directly from the call queue.

V. The USP shall offer a call window. It shall be possible within the call windows to:

1. Switch between cameras associated with the call participant.
2. Open and lock doors associated with the call participant.
3. Arm and Disarm zones associated with the call participant.
4. Trigger outputs associated with the call participant.
5. Put on hold, resume, forward, and end a call.
6. Mute the microphone.
7. Hide the webcam video feed.

W. The USP shall have a built-in address book. The address book shall be available in the call dialog box, in which users can view and manage their list of contacts. From the address book, users shall be able to do the following:

1. Call a contact by simply double-clicking the contact name.
2. See the availability status of their contacts (users and SIP Devices).
3. Quickly display a contact's information, such as photo, name, and number.
4. Filter their contacts by type (SIP Device or User).
5. Create a list of favorites by adding and removing contacts.
6. Search for and call numbers that appear in the contact list.

X. The USP shall provide a graphical dial pad to allow the operator to make calls and dial DTMF tones during a call.

Y. The USP shall provide the ability to send public announcements via a microphone or uploaded pre-recorded messages. The users shall be able to do the following:

1. Create paging zones.
2. Associate any SIP callable entity with a paging zone.
3. Upload pre-recorded messages.
4. Trigger a live or pre-recorded message.

Z. The USP shall provide call reporting capabilities to allow for the investigation of the activities during specific call sessions. The report shall provide the capability to replay audio recordings and watch call sessions that have associated video. The Call report shall provide filters to query the call records by:

1. Date and time
2. Call session duration
3. Involved users and call stations
4. Call events and actions
5. Actions taken by a user on doors, intrusion zones, and outputs during the call session

AA. The USP shall give the capability to export a call session, including bidirectional audio, associated video, and log journal of the call session.

BB. It shall be possible to place the voice devices as icons on a map that shall display the call status of the voice device with a color code. A right-click on the voice device map icon shall allow the user to:

1. Answer or reject an incoming call.
2. Initiate a call to the device.
3. Put on hold and resume a call with the device.

CC. It shall be possible for an operator to select and broadcast his or her availability status, with the possible statuses being Available, Away and Busy. This status will appear with a color code in the call dialog box of other operators.

DD. The Contractor shall provide up to (See Plans) number of SIP connections.

EE. The Contractor shall provide up to (See Plans) number of SIP trunks.

FF. The Contractor shall provide a failover and bidirectional audio and video recording license for each SIP device.

GG. The contractor shall provide up to (See Plans) number of SIP public address.

HH. The CM shall provide the ability to broadcast public addressing messages to a collection of SIP devices included in a paging zone. The PA (Public address) feature shall support the following capability:

1. Define paging zones and assign SIP entities for each of them
2. Broadcast live and pre-recorded messages

2.22 USP GENERAL REQUIREMENTS

A. The Unified Security Platform (USP) shall be an enterprise class IP-enabled security and safety software solution.

B. The USP shall support the seamless unification of IP access control system (ACS), IP video management system (VMS), and IP automatic license plate recognition system (ALPR) under a single platform. The USP user interface (UI) applications shall present a unified security interface

for the management, configuration, monitoring, and reporting of embedded ACS, VMS, and ALPR systems and associated edge devices.

C. Functionalities available with the USP shall include:

1. Configuration of embedded systems, such as ACS, ALPR, and VMS systems.
2. Live event monitoring.
3. Live video monitoring and playback of archived video.
4. Alarm management.
5. Reporting, including creating custom report templates and incident reports.
6. The Federation feature for global monitoring, reporting, and alarm management of multiple remote and independent ACS, VMS, and/or ALPR systems spread across multiple facilities and geographic areas.
7. Global cardholder management across multiple facilities and geographic areas each with their own independent ACS system.
8. Microsoft Active Directory integration for synchronizing USP user accounts and ACS card-holder accounts.
9. Intrusion device and panel integration (live monitoring, reporting, and arming/disarming).
10. SIP Intercom device integration for bi-directional communication.
11. Integration with third party systems and databases via plug-ins (access control, video analytics, point of sale, and more).
12. Dynamic graphical map viewing.
13. Asset management system integration.

D. The USP shall be deployed in one or more of the following types of installations:

1. Unified access, ALPR, video platform, and any combination thereof.
2. Standalone access control, ALPR, or video platform.
3. Unified access and video platform that federates multiple remote ACS, VMS, ALPR.
4. Standalone video platform that federates multiple independent remote VMS.
5. Standalone access control that federates multiple independent remote ACS.
6. Standalone access control that federates multiple independent remote ALPR.

E. Licensing:

1. A single central license shall be applied centrally on the configuration server.
2. There shall be no requirement to apply a license at every server computer or client workstation.
3. Based on selected options, one or more embedded systems shall be enabled or disabled.

F. Hardware and Software Requirements:

1. The USP and embedded systems (video, license plate recognition, and access control) shall be designed to run on a standard PC-based platform loaded with a Windows operating system. The preferred operating system shall be coordinated with the Owner following the manufacturer supported operating systems.
2. The core client/server software shall be built in its entirety using the Microsoft .NET software framework and the C# (C-Sharp) programming language.
3. The USP database server(s) shall be built on Microsoft's SQL Server. The preferred SQL version shall be coordinated with the Owner and compatible with the USP.

4. The USP shall be compatible with virtual environments, including VMware and Microsoft Hyper-V.
5. The USP shall use the latest user interface (UI) development and programming technologies such as Microsoft WPF (Windows Presentation Foundation), the XAML markup language, and .NET software framework.

2.23 USP ARCHITECTURE

A. The USP shall be based on a client/server model. The USP shall consist of a standard Server Software Module (SSM) and Client Software Applications (CSA).

B. The USP shall be an IP enabled solution. All communication between the SSM and CSA shall be based on standard TCP/IP protocol and shall use TLS encryption with digital certificates to secure the communication channel.

C. The SSM shall be a Windows service that can be configured to start when the operating system is booted and run in the background. The SSM shall automatically launch at computer startup, regardless of whether or not a user is logged on the machine.

D. Users shall be able to deploy the SSM on a single server or across several servers for a distributed architecture. The USP shall not be restricted in the number of SSM deployed.

E. The USP shall support the concept of The Federation feature whereby multiple independent ACS, VMS, and ALPR installations can be merged into a single large virtual system for centralized monitoring, reporting, and alarm management.

F. The USP shall protect against potential database server failure and continue to run through standard off-the-shelf solutions.

G. The USP shall support up to one thousand instances of CSA connected at the same time. However, an unrestricted number of CSA can be installed at any time.

H. The USP shall support an unrestricted number of logs and historical transactions (events and alarms) with the maximum allowed being limited by the amount of hard disk space available.

I. The USP shall support uninterrupted video streaming. The CSA shall keep existing video connections active in the event that an SSM (except Archiver) becomes unavailable.

J. Roles-Based Architecture:

1. The USP shall consist of a role-based architecture, with each SSM hosting one or more roles.

2. Each role shall execute a specific set of tasks related to either core system, automatic license plate recognition (ALPR), video (VMS), or access control (ACS) functionalities, among many others. Installation shall be streamlined through the ability of the USP to allow administrators to:

    a. Deploy one or several SSM across the network prior to activating roles.
    b. Activate and deactivate roles as needed on each and every SSM.
    c. Centralize role configuration and management.

d. Support remote configuration.
e. Move roles over from one SSM to another.

3. Each role, where needed, shall have its own database to store events and role-specific configuration information.

4. Roles without databases, such as The Federation feature, Active Directory, and Global Cardholder Management, shall support near real-time standby without any third party fail-over software being required.

5. Directory Role:

a. The Directory Role shall manage the central database that contains all the system information and component configuration of the USP.
b. The Directory Role shall authenticate users and give access to the USP based on predefined user access rights or privileges, and security partition settings.
c. The Directory Role shall support the configuration/management of the following components common to the ACS, ALPR, and VMS sub-systems:

i. Security Partitions, users and user groups
ii. Areas
iii. Zones, input/output (IO) linking rules, and custom output behavior
iv. Alarms. Schedules, and scheduled tasks
v. Custom events
vi. Macros or custom scripts

d. The Directory Role shall support the configuration/management of the following components specific to VMS:

i. Video servers and their peripherals (e.g. audio, IOs, and serial ports)
ii. PTZ
iii. Camera sequences
iv. Recording and archiving schedules

e. The Directory Role shall support the configuration/management of the following components specific to ACS:

i. Door controllers, and input and output (IO) modules
ii. Doors, Elevators, and Access rules
iii. Cardholders and cardholder groups, credentials, and badge templates

f. The Directory Role shall support the configuration/management of the following components specific to ALPR:

i. ALPR units and cameras
ii. Hotlists, permit lists, and overtime rules

6. The Video Archiver Role shall be responsible for managing cameras and encoders under its control and archiving.

7. The Media Router Role shall be responsible for routing video and audio streams across local and wide area networks from the source (for example DVS) to the destination (for example CSA).
8. The Access Manager Role shall be responsible for synchronizing access control hardware units under its control, such as door controllers and I/O modules. This role shall also be responsible for validating and logging all access activities and events when the door controllers and I/O modules are online.
9. The Automatic License Plate Recognition (ALPR) Role shall be responsible for synchronizing fixed ALPR units (cameras) and mobile ALPR applications under its control. The ALPR Role shall also be responsible for logging all ALPR activities and events.
10. The Zone Manager Role shall be responsible for managing all software zones (collection of inputs) and logging associated zone events. Zones shall consist of inputs from both access control and video devices.
11. The Health Monitoring Role shall be responsible for monitoring and logging health events and warnings from the various client applications, roles, and services that are part of the USP. This role shall also be responsible for logging events within the Windows Event Log and for generating reports on health statistics and health history.
12. Optional Roles:

    a. The Active Directory Role shall be responsible for synchronizing user accounts and cardholder accounts with a Microsoft Active Directory server.
    b. The Intrusion Manager Role shall be responsible for managing third party intrusion devices such as alarm panels and perimeter detection devices. This role shall also be responsible for logging all intrusion events in a database.
    c. The Asset Manager Role shall be responsible for integrating and synchronizing with third party asset management systems and logging asset related events. This role shall also be responsible for supporting the execution of asset-related reports such as inventory reports and asset activity reports.
    d. The Plug-in Manager Role shall be responsible for the communication between the USP and third party systems such as video analytics, access control, ALPR, video, and building management systems.
    e. The Web SDK Role shall be responsible for connecting the USP to any application or interface developed with the Web Service SDK. Applications developed with the Web Service SDK shall be platform independent and rely on the REST protocol for communications.
    f. The Communication Management Role shall be responsible for registering the SIP communication endpoints and for managing the call routing.
    g. The Web Server Role shall be responsible for managing incoming Web Client connection and hosting the web pages for the Web Client. The Web Server Role acts as a proxy for the client connections and can be installed in a DMZ for additional security.
    h. The Media Gateway Role shall be responsible for connecting any video stream to a third party system using standard RTSP/RTSPS protocol. This role shall provide access to live and playback video.

K. Server Monitoring Service (Watchdog):

1. The USP shall include a Server Monitoring Service that continuously monitors the state of the Server Software Module (SSM) service.
2. The Server Monitoring Service shall be a Windows service that automatically launches at system startup, regardless of whether or not a user is logged into his account.
3. The Server Monitoring Service shall be installed on all PCs/servers running an SSM. In the event of a malfunction or failure, the Server Monitoring Service shall restart the failed

service. As a last resort, the Server Monitoring Service shall reboot the PC/server should it be unable to restart the service.

2.24 USP ACCESS CONTROL, VIDEO, AND ALPR UNIFICATION

A. The Monitoring UI shall present a true Unified Security Interface for live monitoring and reporting of the ACS, VMS, and ALPR. Advanced live video viewing and playback of archived video shall be available through the Monitoring UI.

B. The Configuration UI shall present a true Unified Security Interface for the configuration and management of the ACS, VMS, and ALPR.

C. The user shall be able to associate one or more video cameras to the following entity types: areas, doors, elevators, zones, alarms, intrusion panels, ALPR cameras, and more.

D. It shall be possible to view video associated to access control events when viewing a report.

E. It shall be possible to view video associated to intrusion panel events when viewing a report.

F. It shall be possible to view video associated to ALPR events when viewing a report.

G. The USP shall support the following Alarm Management functionality:

1. Create and modify user-defined alarms. An unrestricted number of user-defined alarms shall be supported.
2. Assign a time schedule or a coverage period to an alarm. An alarm shall be triggered only if it is a valid alarm for the current time period.
3. Set the priority level of an alarm and its reactivation threshold.
4. Define whether to display live or recorded video, still frames or a mix once the alarm is triggered.
5. Provide the ability to display live and recorded video within the same video tile using picture-in-picture (PiP) mode.
6. Provide the ability to group alarms by source and by type.
7. Define the time period after which the alarm is automatically acknowledged.
8. Define the recipients of an alarm. Alarm notifications shall be routed to one or more recipients. Recipients shall be assigned a priority level that prioritizes the order of reception of an alarm.
9. Define the alarm broadcast mode. Alarm notifications shall be sent using either a sequential or an all-at-once broadcast mode.
10. Define whether to display the source of the alarm, one or more entities, or an HTML page.
11. Specify whether an incident report is mandatory during acknowledgment.

H. The workflows to create, modify, add instructions and procedures, and acknowledge an alarm shall be consistent for access control, ALPR, and video alarms.

I. Alarms shall be federated, allowing global alarm management across multiple independent USP, ACS, VMS, and ALPR systems.

J. The USP shall also support alarm notification to an email address or any device using the SMTP protocol.

K. The ability to create alarm-related instructions shall be supported through the display of one or more HTML pages following an alarm event. The HTML pages shall be user-defined and can be interlinked.

L. Alarm unpacking and packing shall be supported where all the entities associated to an alarm can be display in the Monitoring UI with the single click of a button.

M. The user shall have the ability to acknowledge alarms, create an incident upon alarm acknowledgement, and put an alarm to snooze.

N. The user shall be able to spontaneously trigger alarms based on something they see in the system.

O. An alarm shall be configured in such a way that it remains visible until the source condition has been acknowledged.

P. The user shall be able to investigate an alarm without acknowledging it.

2.25 USP THREAT LEVELS

A. The USP shall support Threat Levels to dynamically change the system behavior to respond to critical events.

B. Threat Levels shall be activated and deactivated by the CSA operator with the right privilege.

C. Threat Levels shall be set on an area or on the entire system.

D. Threat Levels shall affect the system behavior by executing any action available in the USP such as: trigger output, start recording, block camera, override recording quality, arm zone, set a door in maintenance mode, and more.

E. The following specific actions shall be available with Threat Level:

1. Set minimum security clearance to restrict or permit access to cardholders on specific areas on top of the restrictions imposed by the access rules.
2. Set minimum user level to automatically log out user from the USP.
3. Set reader mode to change how the doors are accessed (for example card and PIN, or card or PIN).

F. A visible notification shall be displayed in all operator CSA when a Threat Level is activated.

2.26 USP REMOTE TASK

A. The USP shall provide, through a Remote Task, capabilities to remotely monitor and control the content of other workstations running the CSA (Monitoring UI) that are part of the same system.

B. The USP shall support video wall applications by connecting and controlling multiple workstations and monitors simultaneously.

C. The Remote Task shall be a graphical interface showing a replication of the remote workstation running the CSA (Monitoring UI).

D. The Remote Task shall allow the connection to other workstations using a low bandwidth mode to receive only snapshots of video viewed remotely.

E. The Remote Task shall allow the connection to other workstations using a spy mode to remain invisible to the remotely connected workstation. The spy mode option should be available to the user with permission to access the feature.

F. The functionality provided by the remote monitoring and control capability shall include:

1. Remote monitoring and control of the monitoring and alarm monitoring tasks.
2. Ability to remotely switch cameras, doors and zones into display tiles.
3. Ability to remotely control live and playback video.
4. Ability to remotely change the tile pattern.
5. Ability to remotely create and delete tasks.
6. Ability to remotely start/stop task cycling.
7. Ability to remotely go into full screen mode.
8. Ability to remotely save and reload the workspace.

2.27 USP ADVANCED TASK MANAGEMENT

A. USP shall support an infrastructure for managing Monitoring UI tasks used for live monitoring, day to day activities, and reporting.

B. Administrators shall be able to assign tasks and lock the operator's workspace. The user management of their workspace shall be limited by their assigned privileges.

C. Operators shall be able save their tasks as either Public tasks or Private tasks and in a specific partition. Public tasks shall be available to all users. Private tasks shall only be available to the owner of the task.

D. Operators shall be able to share their tasks by sending them to one or more online users. Recipients shall have the option to accept the sent task.

E. Operators shall be able to duplicate a task.

2.28 USP REPORTING

A. The USP shall support report generation (database reporting) for access control, ALPR, video, and intrusion.

B. Each and every report in the system shall be a USP task, each associated with its own privilege. A user shall have access to a specific report task if they have the appropriate privilege.

C. The workflows to create, modify, and run a report shall be consistent for access control, ALPR, and video reports.

D. Reports shall be federated, allowing global consolidated reporting across multiple independent USP, ACS, VMS, and ALPR systems.

E. Access control and ALPR reports shall support cardholder pictures and license plate pictures, respectively.

F. The USP shall support the following types of reports:

1. Alarm reports
2. Video-specific reports (archive, bookmark, motion, and more)
3. Configuration reports (cardholders, credentials, units, access rules, readers/inputs/outputs, and more)
4. Activity reports (cardholder, cardholder group, visitor, credential, door, unit, area, zone, elevator, and more)
5. ALPR-specific reports (mobile ALPR playback, hits, plate reads, reads/hits per day, reads/hits per ALPR zone, and more)
6. Health activity and health statistics reports
7. Other types of reports, including visitor reports, audit trail reports, incident reports, and time and attendance reports

G. Generic Reports, Custom Reports, and Report Templates:

1. The user shall the option of generating generic reports from an existing list, generating reports from a list of user-defined templates, or creating a new report or report template.
2. The user shall be able to customize the predefined reports and save them as new report templates. There shall be no need for an external reporting tool to create custom reports and report templates. Customization options shall include setting filters, report lengths, and timeout period. The user shall also be able to set which columns shall be visible in a report. The sorting of reported data shall be available by clicking on the appropriate column and selecting a sort order (ascending or descending).
3. All report templates shall be created within the Monitoring UI.
4. These templates can be used to generate reports on a schedule in PDF or Excel formats.
5. An unrestricted number of custom reports and templates shall be supported.

H. A reporting task layout shall consist of panes with settings (report length, filters, go and reset commands, etc.), the actual report data in column format, and a pane with display tiles. The user shall be able to drag and drop individual records in a report onto one or more display tiles to view a cardholder's picture ID, playback a video sequence, or an ALPR event.

I. The USP shall support comprehensive data filtering for most reports based on entity type, event type, event timestamp, custom fields, and more.

J. The reporting task shall have the ability to display results through graphics such as line charts, bar charts, stacked bar charts, doughnut charts, and pie charts.

K. The user shall be able to click on an entity within an existing report to generate additional reports from the Monitoring UI.

L. The USP shall support the following actions on a report: print report, export report to a PDF/Microsoft Excel/CSV file, export the graphics chart in JPG/PNG, and automatically email a report based on a schedule and a list of one or more recipients.

2.29 USP DASHBOARDS

A. The USP shall support the ability to create dashboards.

B. Operators shall be allowed to view dashboards if they are granted the appropriate privilege. Modification to dashboards should also be allowed to users granted the appropriate privilege.

C. Dashboards in the system shall be a USP task. A user shall have access to a specific dashboard task if they have the appropriate privilege.

D. Dashboards shall be saved either in a private folder or a public folder.

E. A dashboard shall consist of a canvas with carious widgets displayed on the canvas. All widgets should offer the ability to specify location and size to the widget, a title to the widget, a background color to the widget, and the ability to refresh periodically the content of the widget.

F. Dashboard widget types shall be:

1. Image: provides the ability to display an image (JPG, PNG, GIF, BMP) on a dashboard.
2. Text: provides the ability to display a text on a dashboard. The text style shall be configurable, so font, size, color, and alignment can be specified by the user.
3. Tile: provides the ability to display any entity of the USP inside of a tile.
4. Web page: provides the ability to display a URL on a dashboard.
5. Entity Count: provides the ability to display the total number of a specific entity type in the USP.
6. Reports: provides the ability to display the results of any saved reports in the system. The results shall be displayed either by showing the total number of results in the report, a set of top results from the report, or a visual graph from the data returned by the report.

G. It shall be possible to extend to the widgets of a dashboard using the SDK. This will provide the ability to develop custom widgets to the system.

H. The USP shall support the following actions on a dashboard: print dashboard, export dashboard to PNG file, and automatically email a report based on a schedule and a list of one or more recipients.

2.30 USP FEDERATION FEATURE: MONITORING OF REMOTE SYSTEMS

A. The USP shall support the concept of a Federation feature for access control, video, and ALPR.

B. The Federation feature shall allow multiple independent USP systems (Federated systems) to be unified into a larger virtual system (the Federation feature). This shall facilitate the global monitoring of multiple independent USP systems.

C. The Federation feature shall support the unification of multiple independent video surveillance systems or VMS.

D. Entities that shall be federated and monitored centrally from the Federation feature shall include alarms, areas, cameras, cardholders and cardholder groups, credentials, doors, elevators, ALPR events, and zones (monitored inputs).

E. The Federation feature shall support a cloud-based deployment, whereby the service and infrastructure will be updated automatically and provisioned by the service provider, without need for on-site hardware.

F. The Federation feature shall support Global Alarm Management from the Monitoring UI for access control, video, and ALPR.

G. The Federation feature shall support Global Report Generation from the Monitoring UI for access control, video, and ALPR.

H. The Federation feature shall support dozens of operator actions on remote (federated) entities from the Monitoring UI (for example, generating a global report taking into account events from multiple independent sites or acknowledging remote alarms).

2.31 USP ZONE MANAGEMENT

A. The USP shall support the configuration and management of zones for input point monitoring via the Zone Manager Role. A user shall be able to add, delete, or modify a zone if they have the appropriate privileges.

B. A zone shall monitor the status of one or more inputs points. Zone monitoring or input point monitoring shall be possible through the use of a controller and one or more input modules. Inputs from video cameras or video encoders shall also be accessible via a zone.

C. Depending on the hardware installed, supervised inputs shall be supported. Depending on the input module used, both 3-state and 4-state supervision shall be available.

D. A schedule shall be defined for a zone, indicating when the zone will be monitored.

E. Custom Events shall provide full flexibility in creating custom events tailored to a zone. Users shall be able to associate custom events to state changes in monitored inputs.

F. The ACS shall support one or more cameras per zone. Video shall then be associated to zone state changes.

G. Input/Output (IO) Linking:

1. Zone management shall support Input/Output (IO) Linking. I/O Linking shall allow one or more inputs to trigger one or more outputs.
2. IO Linking shall be available in offline mode when communication between the server and hardware is not available.
3. Custom Output Behaviors shall provide full flexibility in creating a variety of complex output signal patterns: simple pulses, periodic pulses, variable duty-cycle pulses, and state changes.
4. Through the “trigger an output” action, the ACS shall support the triggering of outputs with custom output behaviors.

2.32 USP USER AND USER GROUP SECURITY, PARTITIONS, AND PRIVILEGES MANAGEMENT

A. The USP shall support the configuration and management of users and user groups. A user shall be able to add, delete, or modify a user or user group if they have the appropriate privileges.

B. The USP shall support user authentication with claims-based authentication using external providers. External providers shall include:

1. ADFS (Active Directory Federation Services)
2. Azure Active Directory (through OpenID Connect)
3. Ping Identity (through OpenID Connect)
4. KeyCloak (through OpenID Connect)
5. Other Open ID Connect / SAML2 authentication agents

C. Common access rights and privileges shared by multiple users shall be defined as User Groups. Individual group members shall inherit the rights and privileges from their parent user groups. User group nesting shall be allowed.

D. User privileges shall be extensive in the USP. All configurable entities for the USP, including access control, video, and ALPR shall have associated privileges.

E. Specific entities, such as cardholders, cardholder groups, and credentials shall include a more granular set of privileges, such as the right to access custom fields and change the activation or profile status of an entity.

F. Partitions:

1. The USP shall limit what users can view in the configuration database via security partitions (database segments). The administrator, who has all rights and privileges, shall be allowed to segment a system into multiple security partitions.
2. All entities that are part of the USP can be assigned to one or more partitions.
3. A user who is given access to a specific partition shall only be able to view entities (components) within the partition to which they have been assigned. Access is given by assigning the user as an accepted user to view the entities that are members of a particular partition.
4. A user or user group can be assigned administrator rights over the partition.

G. It shall be possible to specify user and user group privileges on a per partition basis.

H. Advanced logon options shall be available such as dual logon and more.

I. It shall be possible to specify an inactive period for the Monitoring UI after which time the application shall automatically lock, while still preserving access to currently displayed camera feeds.

J. It shall be possible to review user permissions and determine:

1. For any entity in the system, which user group or user can view or modify it.
2. For any user group or user in the system, what are its privileges.
3. For any privilege in the system, which user group or user is allowed to perform the underlying action.

2.33 USP EVENT/ACTION MANAGEMENT

A. The USP shall support the configuration and management of events for video and ALPR. A user shall be able to add, delete, or modify an action tied to an event if he has the appropriate privileges.

B. The USP shall receive all incoming events from one or more ACS, VMS, and/or ALPR. The USP shall take the appropriate actions based on user-define event/action relationships.

C. The USP shall receive and log the following events:

1. System-wide events
2. Application events (clients and servers)
3. Area, camera, door, elevator, and ALPR events (reads and hits)
4. Unit events
5. Zone events
6. Alarm events
7. ALPR events
8. Health Monitoring events

D. The USP shall allow the creation of custom events.

E. The USP shall have the capability to execute an action in response to an access control, video, and ALPR event. The USP shall support the following list of actions, without being limited to:

1. Add bookmark
2. Arm intrusion detection area
3. Arm zone
4. Block and unblock video
5. Bypass input
6. Cancel postpone intrusion detection area arming
7. Clear input bypass
8. Clear task
9. Display a camera on an analog monitor
10. Display an entity in the CSA
11. Email a report
12. Email a snapshot
13. Export report
14. Forgives antipassback violation
15. Go home
16. Go to preset
17. Import from file
18. Override recording quality
19. Override with event recording quality
20. Override with manual recording quality
21. Play a sound
22. Postpone intrusion detection area arming
23. Reboot unit
24. Recording quality as standard configuration
25. Rest area people count

26. Reset parking zone inventory
27. Run a macro
28. Run a pattern
29. Send a message
30. Send a task
31. Send an email
32. Set parking zone occupancy
33. Set reader mode
34. Set the door maintenance mode
35. Set threat level
36. Start/Stop applying video protection
37. Start/Stop recording
38. Start/Stop transfer
39. Synchronize role
40. Temporary override elevator schedules
41. Trigger intrusion alarm
42. Trigger alarm
43. Trigger output
44. Trigger read
45. Unlock door explicitly

F. The USP shall allow a schedule to be associated with an action. The action shall be executed only if it is an appropriate action for the current time period.

2.34 USP SCHEDULES AND SCHEDULED TASKS

A. Schedules

1. The USP shall support the configuration and management of complex schedules. A user shall be able to add, delete, or modify a schedule if they have the appropriate privileges.
2. The USP shall provide full flexibility and granularity in creating a schedule. The user shall be able to define a schedule in 1-minute or 15-minute increments.
3. Daily, weekly, ordinal, and specific schedules shall be supported.

B. Scheduled Tasks

1. The USP shall support scheduled tasks for video, and ALPR.
2. Scheduled tasks shall be executed on a user-defined schedule at a specific day and time. Recurring or periodic scheduled tasks shall also be supported.
3. Scheduled tasks shall support all standard actions available within the USP, such as sending an email or emailing a report.

USP MACROS AND CUSTOM SCRIPTS

A. The USP shall enable users to automate and extend the functionalities of the system through the use of macros or custom scripts for access control, video, and ALPR.

B. Custom macros shall be created with the USP Software Development Kit (SDK).

C. A macro shall be executed either automatically or manually.

D. In the Monitoring UI, a macro shall be launched through hot actions.

2.35 USP DYNAMIC GRAPHICAL MAPS (DGM)

A. The USP shall support mapping functionality for access control, video surveillance, intrusion detection, ALPR, and external applications.

B. The USP shall provide a map centric interface with the ability to command and control all the USP capabilities from a full screen map interface.

C. It shall be possible to span the map over all screens of the USP client station. In the scenario where the map is spanned over all the screens of the USP client station it shall be possible to navigate the map including pan and zoom, and the map's moves shall be synchronized between all screens. Spanning the map over multiple screens must provide the same command and control capabilities than in a single screen display.

D. The DGM shall support the following file format and protocol for importing map background:

1. PDF
2. JPG
3. PNG
4. Web Tile Map Service (WTMS) and Web Map Service (WMS) defined by the Open Geospatial Consortium (OGC)
5. BeNomad
6. AutoCAD (DWG & DXF)

E. The DGM shall provide the following online map providers for use as map background and provide the ability to manage their service license if they require one:

1. Google Map, aerial, terrain (Licensed)
2. Bing Map, aerial, satellite, hybrid (Licensed)
3. ESRI ArcGIS (Licensed)
4. OpenStreet Map aerial (Licensed)
5. OVI hybrid

F. It shall be possible to configure a mixed set of maps made of GIS, online providers, and private imported files and link them together.

G. The DGM shall provide the ability to display all native entities of the USP including:

1. Cameras, fix, and PTZ
2. Doors
3. Camera sequences
4. Areas
5. Intrusion areas
6. Intrusion zones
7. License Plate Recognition cameras
8. Digital inputs

9. Digital outputs
10. Intercoms
11. Alarms
12. Macros
13. Police Car Patrollers

H. The DGM shall provide the ability to draw and display information over the map in the form of:

1. Vectoral shapes: lines, rectangles, polygons, ellipse
2. Pictures
3. Text

I. The DGM shall provide the ability to display any type of third party entities integrated through an SDK.

J. The DGM shall provide the ability to display layer of information in Keyhole Markup Language (KML) format.

K. The DGM shall provide the ability to the operator to manage layers of entities displayed over the map, being able to turn them on and off and changing the superposition order.

L. The DGM shall provide the ability to import data layers from one or more ESRI ArcGIS servers.

M. The DGM shall provide the operators with the ability to manage layers that are imported from ESRI ArcGIS. The operators shall be able to turn the layers on and off, as well as sort the layers.

N. The DGM shall offer built-in map data backup and restore for both map background and layers of entities.

O. The DGM shall provide the ability to import configuration from an eternal file such as:

1. AutoCAD layer for objects
2. CSV, Excel file

P. The DGM shall offer failover capabilities.

Q. The DGM shall scale up to several thousands of entities on a single map and hundreds of maps.

R. The DGM shall provide a means to update a map background without affecting the map object configuration.

S. The DGM shall offer a user-friendly graphical map designer to configure the maps.

T. The DGM shall provide a user friendly and intuitive navigation that includes:

1. The ability to create hierarchies of maps to facilitate navigation within and between various sites and buildings.
2. The ability to define favorites for recurrent position recall.
3. The possibility to create links between maps. The map links shall allow the link from one map to multiple maps representing the floors of a building. Navigating between floors of a building shall keep the zoom level of the map.

U. It shall be possible to monitor the state of entities on the map. It shall be possible to customize the icons of any entities represented on the map.

V. The DGM shall offer the ability to optionally set a graphical display notification of the motion detection.

W. The DGM shall offer a smart selection too to access the video. By clicking the location the user wants to see, the DGM will automatically select the cameras that can see this location and move the PTZ towards that location. This smart selection too shall take obstacles into consideration and not display cameras that cannot see the location because of a wall.

X. It shall be possible to select a location by drawing a zone of interest on the DGM, and to display all the entities that are part of that zone or interest at once.

Y. The user shall be able to select and display the content of multiple USP entities on the map in pop-up windows.

Z. The user shall be able to move, resize, and pain the USP entity pop-up windows to the map.

AA. It shall be possible to access live and playback video from the map.

BB. It shall be possible to monitor all entity event notifications from the DGM. Users shall be able to turn notifications on and off per entity.

CC. The DGM shall offer the ability to fully operate alarm monitoring. It shall be possible to:

1. Center the map on entities related to the alarm.
2. Visualize the Alarm notifications on the map and access the related videos from the map.
3. Trigger and receive alarms.
4. Act on the alarm from the DGM, including acknowledgements, forwarding, and investigation.
5. Visualize that an alarm occurred in an underlying linked map.

DD. The DGM shall provide the following search capabilities:

1. Search and center by entity name.
2. From the Display of an entity in the USP, locate the entity on the map and offer the ability to select another one close-by.
3. By street address, city, landmark, point of interest (using geocoder license from Google, ESRI, or other provider)

EE. Any update of map content by an administrator shall be immediately and dynamically pushed to all DGM users.

FF. The DGM shall support the use of GIS maps, private maps, or a combination of both for the map background.

GG. The DGM shall be compatible with any GIS compliant maps with the OGC and supporting WMTS and WMS. This includes, but is not limited to, ESRI maps. The DGM shall allow the selection of the appropriate GIS layers.

HH. The DGM shall provide an intuitive built-in map designer for entity positioning on the map using drag and drop. Any configuration shall be graphic.

II. It shall be possible to edit and configure multiple map objects at once.

JJ. All map design modifications shall be logged in an audit trail.

KK. Various actions shall be available within maps for execution through simple and intuitive double-click, right-click, or drag-and-drop functionality. Examples of actions available through maps shall include unlocking a door and acknowledging an alarm.

LL. Through the following functionalities, the DGM shall allow the management of USP alarms from the map

1. Locate on the map entities related to the alarm.
2. Display entities of the alarm with a specific icon, color, transparency level, and blinking rate.
3. List, select, and locate alarms.
4. Auto center the map on the highest priority alarm.
5. Handle the alarm from the map, including acknowledgement, forwarding, and investigation.
6. All map containers, such as hotspots or map links, shall reflect the alarm status of the contained entities.

MM. It shall be possible to add advanced functionality to map objects using the SDK. Any functionality available through the USP SDK shall be available within maps.

NN. The DGM shall offer lasso tools for:

1. Displaying entities at one location through a single action.
2. Triggering an action on all entities at one location in a single click.
3. Editing multiple entities at one location simultaneously.

OO. The DGM shall allow the display of USP entities selected from the map on a remote monitor (video wall).

PP. The DGM shall provide the ability to search within the map by entity name.

QQ. The DGM shall allow the use of KML overlay map information for both GIS and private maps. Moveable objects shall be supported using the KML.

RR. The Contractor shall provide licenses for each entity that is required to be shown on the graphical maps.

2.36 USP DIGITAL EVIDENCE MANAGEMENT SYSTEM (DEMS)

A. The USP shall support the ability to electronically share video exports with third parties.

B. The USP shall allow recipients to natively review exported video from a web browser, without the need to install software or browser plugins.

C. Video exported from the UPS will include the original file and timestamp information, as well as the system, workstation, and camera source metadata that can be viewed from the DEMS.

D. The USP shall support the ability to create a case within the DEMS, and assign associated incident details, when exporting video.

2.37 USP AUDIT AND USER ACTIVITY TRAILS (LOGS)

A. The USP shall support the generation of audit trails. Audit trails shall consist of logs of operator/administrator additions, deletions, and modifications.

B. Audit trails shall be generated as reports. They shall be able to track changes made within specific time periods. Querying on specific users, changes, affected entities, and time periods shall also be possible.

C. For entity configuration changes, the audit trail report shall include detailed information of the value before and after the changes.

D. The USP shall support the generation of user activity trails. User activity trails shall consist of logs of operator activity on the USP such as login, camera viewed, ALPR event viewed, badge printing, video export, and more.

E. The ACS shall support the following actions on an audit and activity trail report: print report and export report to a PDF/ Microsoft Excel/CSV file.

2.38 USP INCIDENT REPORTS

A. Incident reports shall allow the security operator to create reports on incidents that occurred during a shift. Both video-related and access control-related incident reports shall be supported.

B. The operator shall be able to create standalone incident reports or incident reports tied to alarms.

C. The operator shall be able to link multiple video sequences to an incident, access them in an incident report, and change the date or time of the sequences later on.

D. It shall be possible to create a list of Incident categories, tag a category to an incident, and filter the search with the category as a parameter.

E. Incident reports shall allow the creation of a custom form on which to input information on an incident.

F. Incident reports shall allow entities, events, and alarms to be added to support at the report's conclusions.

2.39 USP DATA INGESTION

A. The USP Shall allow the possibility to import external data from outside sources to enhance unification of data sources within the USP.

B. Each data source shall be defined by a set of fields and field types that describe the data source. Field types shall be:

1. String
2. 32 bit & 64 bit integer
3. Floating point number
4. Boolean
5. Timestamp
6. Binary (in a file or base 64)

C. The visualization of each data point from a data source shall be configurable to determine what fields from the data should be displayed. The configuration of each field shall be:

1. Which fields are displayed or hidden
2. What order are the fields displayed
3. A label to specify the name of the field (to have a key:value format)
4. An option to specify how to display the field (text value, Image, clipboard value, hyperlink to a web page, hyperlink to an entity in the system, sound file)

D. A privilege should be available for each data source to allow / deny access to specific user & user groups of the USP.

E. Ingested data shall be available in the USP reporting system.

F. Ingested data shall be available to display in the USP Dashboards.

2.40 USP THIRD PARTY INTEGRATION

A. Microsoft Active Directory Integration

1. The USP shall support a direct connection to one or multiple Microsoft Active Directory server via the Active Directory Role(s). Active Directory integration shall enable the synchronization of information from the Active Directory server to the USP.
2. Active Directory integration shall permit the central management of the USP users, user groups, cardholders, and cardholder groups.
3. The USP shall be able to connect to and synchronize data from multiple Active Directory servers (up to 10).
4. The USP shall support synchronizing Active Directory Universal Groups as well as security groups belonging to other domains within the same forest.
5. The USP shall support Microsoft Active Directory encryption using LDAP SSL.
6. When enabled, Active Directory shall manage user logon to the USP client applications through the user's Windows credentials. Logging on to the USP shall utilize native Active Directory password management and authentication features.
7. It shall be possible to synchronize the following USP entities and their information from Active Directory with the USP:

   a. Users (username, first and last names, email address, and more)
   b. User groups (user group name, description, and group email address)
   c. Active Directory attributes to USP custom fields

8. When enabled, the addition, removal, or suspension of a user's Windows account in Active Directory shall result in the creation, deletion, or disabling of the equivalent user account in the USP.
9. Supported synchronization methods for additions, modification, and deletions of synchronized entities shall include on first logon (users only), manual synchronization, and scheduled synchronization.
10. The USP shall support user connections across independent organizations by connecting to an identity provider using claims-based authentication such as ADFS (Active Directory Federation Services), Azure Active Directory, other OpenID Connect & SAML2 providers.

B. Intrusion Detection Integration:

1. The USP shall integrate with third party intrusion panels and devices via an Intrusion SDK. The Intrusion Manager Role shall manage communications with the intrusion panels. Communications with intrusion devices shall be over serial communications and/or an IP network.
2. Integration with intrusion panels shall be possible outside the release cycle of the USP. It shall be possible to add new integrations at any point in time.
3. Functionality available via the integration of intrusion devices with the USP shall include the following (where supported by the intrusion panel):

    a. Arm and disarm intrusion devices (manually, on schedule, or following a USP event).
    b. Activate or trigger intrusion device outputs.
    c. View intrusion events and alarms.
    d. Monitor the status, including arming status, of the intrusion devices.
    e. Video verification of intrusion events and alarms with video panels.
    f. Create USP zones using intrusion device inputs.

4. Currently supported intrusion panels include:

    a. Bosch G Series panels
    b. DSC Power Series panels
    c. DMP XR Series panels
    d. Honeywell Galaxy Dimension and Flex panels
    e. Vanderbilt SPC
    f. UTC Advisor Master and Advanced
    g. Bosch Map 5000

5. Additional intrusion devices supported:

    a. Buytime
    b. Alarm Panel Receiver
    c. Southwest Microwave RPMII

C. Third Party Access Control Systems:

1. The USP shall integrate with third party access control software via the SDK. Communications with access control software shall be over an IP network, and should not support administrative tasks such as cardholder management.

2. Integration with access control software shall be possible outside the release cycle of the USP. It shall be possible to add new integrations at any point in time.
3. Functionality available via the integration of access control software with the USP shall include the following (where supported by the access control solution):

    a. Synchronize access control entities and receive associated events and states within the USP, including:

        i. Cardholders and access rights
        ii. Visitors
        iii. Readers and doors
        iv. Alarms
        v. Inputs and outputs

    b. Monitor access control events.
    c. Monitor and Acknowledge access control alarms.
    d. Trigger actions and outputs in the access control software using hot actions and event-to-actions.
    e. Lock and unlock doors in the access control software.
    f. Video verification of access control events and alarms.
    g. Configure event-to-actions using the access control events and alarms.
    h. Generate Security Center reports using from the in the access control data.
    i. View and monitor states of door entities in the USP maps.

4. Currently supported access control manufacturers include:

    a. Tyco Softwarehouse CCURE
    b. UTC Lenel Onguard
    c. Amag Symmetry
    d. Siemens Sipass
    e. AssaAbloy ARX

D. Third Party Destination Dispatch Systems:

1. The USP shall integrate with third part destination dispatch (elevator control0 software via the SDK. Communications with the destination dispatch software shall be over an IP network.

2. Integration with destination dispatch software shall be possible outside the release cycle of the USP. It shall be possible to add new integrations at any point in time.

3. Functionality available via the integration of destination dispatch software with the USP shall include the following (where supported by the destination dispatch solution):

    a. Destination dispatch entity creation and reception of associated events and states within the USP, including:

        i. Floors and landings
        ii. Elevator cars (front/rear doors) and kiosks
        iii. Cardholders and credentials (if applicable)

b. Monitor destination dispatch events.
c. Trigger manual dispatch actions.
d. Video verification of destination dispatch events.
e. Configure event-to-actions using the destination dispatch events.
f. Generate Security Center reports using the destination dispatch data.
g. Support multiple readers

i. Kiosk internal readers
ii. USP readers

h. Kiosk advanced modes and passenger types.

4. Currently supported destination dispatch manufacturers include:

a. Otis Compass
b. Thyssenkrupp
c. Schindler
d. MCE

E. Asset Management Integration:

1. The USP shall integrate with third party asset management systems via the Asset Management Role.
2. Communications with asset management solutions shall be over an IP network (via software communications).
3. Functionality available via the integration of asset management systems with the USP shall include the following (where supported by the asset management systems):

a. Synchronize asset management system assets with USP asset entities.
b. Live monitoring of asset-related activity events, health events, and activity (asset online, asset offline, asset moves, or low battery).
c. Synchronization of asset management alarms with Security Center alarms.
d. Viewing video tied to asset-related activity and alerts within monitoring and reporting tasks.
e. Acknowledging alarms in Security Center which acknowledges alerts in the asset management system and vice versa.
f. Real-time tracking of asset locations on a per area basis.
g. Asset Management Inventory reporting task that details the current location (area) of an asset.
h. Asset Activity reporting task that provides a historical review of asset-related events and activity.

4. Currently supported asset management systems include:

a. Deister Key management
b. Morse watchmans
c. TRAKA

F. Additional Third Party Integrations:

1. The USP shall support multiple approaches to integrating third party systems. These shall include: Software Development Kits (SDKs), REST-based Web Service SDKs, RTSP Service SDKs, and more.
2. The USP architecture shall support the addition of new connectors to integrate to third party system integration, such as:

    a. Video analytics
    b. Third party video systems
    c. Third party access control systems
    d. ALPR integrations with pay stations, permit vendors, pay-by-phone vendors, and ticketing vendors
    e. Building management systems
    f. Access Control ecosystem (such as ID scanner, card synchronization, Guardtour, Morpho Biometrics)
    g. Transaction monitoring (POS, Barcode scanning, ATM)
    h. Industrial IoT (Modbus, BACnet, OPC, SNMP)
    i. Industrial Protocol Interface (BACnet, Modbus)
    j. Videowall (Barco, Eizo)
    k. Human resource management systems (HRMS)
    l. Autonomous Drone Integration
    m. Intelligent Keys (Salto SVN, Medeco XT, CLIQ)
    n. Gunshot Detection (Shot Spotter, Guardian GunShot)
    o. Dynamic Logbook
    p. Facial Recognition Framework
    q. Real-time Location Services - RTLS (HID)

2.41 USP SOFTWARE DEVELOPMENT KIT (SDK)

A. A USP SDK shall be available to support custom development for the platform.

B. The SDK shall include functionalities specific to the embedded automatic license plate recognition (ALPR), access control (ACS), and video (VMS) systems.

C. Integration with external applications and databases shall be possible with the SDK.

D. The SDK shall enable end-users to develop new functionality (user interface, standalone applications or services) to link the USP to third party business systems and applications, such as Badging Systems, Human Resources Management Systems (HRMS), and Enterprise Resource Planning (ERP) systems.

E. The SDK shall be based on the .NET framework.

F. The SDK shall support dynamic or transactional updates to the USP configuration. It shall also support change notification of USP entity configuration.

G. The SDK shall provide an extensive list of programming functions to view and/or configure core entities such as: users and user groups, alarms, custom events, and schedules, and more.

H. The SDK shall provide an extensive list of programming functions to view and configure ACS, VMS, and ALPR.

I. The SDK shall provide an extensive list of programming functions to view and configure most ACS entities such as: cardholders, cardholder groups, visitors, credentials, access rules (modify only), and custom fields.

J. The SDK shall be able to receive real time events from the following USP entities: users and user groups, areas, zones, cameras, video units, doors, door controllers (units), elevators, cardholders, cardholder groups, and credentials.

K. The SDK shall be able to query the history of events for areas, cameras, zones, alarms, cardholders, credentials, visitors, doors, query license plate read events, license plate hit events, generate a license plate hits report, generate a license plate reads report.

L. The SDK shall support the following alarm functions: view alarms in real time, acknowledge alarms, change priority, and change recipient.

2.42 NETWORK CAMERAS

A. Dome Camera – Scene Cameras

1. 4K indoor dome with IR and deep learning shall be AXIS P3268–LV

2. Provide recessed mounting kits for interior finished spaces.

3. Provide wall mount kits for penthouse areas.

4. Provide pendant kits for garage areas.

B. Dome Camera – Halls or Corridors

1. 4 MP indoor dome with IR and deep earning shall be AXIS M4216-LV

2. Provide recessed mounting kits for interior finished spaces.

C. Panoramic Scene Camera – 180 Degree Dome Camera

1. Panoramic 14 MP network camera shall be AXIS Q3819-PVE

2. Provide recessed mounting kits for interior finished spaces.

3. Provide wall mount kits for penthouse areas.

D. Provide pendant kits for garage areas. Multi Imager Dome Camera – Lobbies, Parking Garage and Building Perimeters

1. Exterior 15MP panoramic network camera shall be AXIS P3719-PLE

2. Provide recessed mounting kits for interior finished spaces.

3. Provide wall mount kits for penthouse areas.

4. Provide pendant kits for garage areas.

5. Provide corner wall mount kits on where shown building exteriors.a

E. Elevator Camera – Elevator Cabs

1. The 3MP fixed dome network camera shall be AXIS P9106-V

F. License Plate Camera – Vehicle Gates

1. The fixed bullet 1080p HDTV license plate camera shall be AXIS Q1700-LE
2. The specified product shall meet or exceed the following design specifications:

   a. The camera shall operate on an open source and Linux-based platform, and include a built-in web server.
   b. The camera shall be equipped with an IR-sensitive progressive scan megapixel sensor.
   c. The camera shall provide a removable IR-cut filter in day mode and infrared-pass filter 720 nm in night mode.
   d. The camera shall be equipped with a 18-137 mm lens.
   e. The camera shall provide a horizontal field of view between 16° and 2.3° and a vertical field of view between 9.6° and 1.3°
   f. The camera shall be manufactured with a wind survivability of 60 m/s (134 mph).
   g. The camera shall provide local video storage utilizing a microSD/microSDHC/microSDXC memory card expansion.
   h. The camera shall be manufactured with an IP66-, IP67-, and NEMA 4X-rated, IK10 impact-resistant aluminum enclosure with integrated dehumidifying membrane, IK08 impact-resistant glass front window and weather shield with black anti-glare coating.

3. The specified product shall meet or exceed the following performance specifications:

   a. Illumination

      1) The camera shall meet or exceed the following illumination specifications:

         i. Color: 0.16 lux
         ii. B/W: 0.03 lux
         iii. 0 lux with IR illumination on

   b. Resolution

      1) The camera shall be designed to provide video streams in HDTV 1080p (1920x1080) at up to 60 frames per second (60Hz mode) or 50 frames per second (50Hz mode) using H.264 or Motion JPEG.
      2) The camera shall support video resolutions including:

         a) 1400x1050 (4:3)
         b) 1280x960 (4:3)
         c) 1920x1080 (HDTV 1080p)
         d) 1280x720 (HDTV 720p)

      3) The camera shall provide maximum pixel density with 8x optical zoom:

a) 25 m (82 ft): 1912 px/m
b) 50 m (164 ft): 956 px/m
c) 250 m (820 ft): 191 px/m

4) The camera shall provide landscape format as well as the possibility to adjust the image to stream in corridor format.

c. Encoding

1) The camera shall provide independently configured simultaneous H.264 and Motion JPEG streams.
2) The camera shall provide configurable compression levels.
3) The camera shall support standard baseline profile with motion estimation.
4) The camera shall support motion estimation in H.264/MPEG-4 Part 10/AVC.
5) The camera shall support the following video encoding algorithms:

a) Motion JPEG encoding in a selectable range from 1 up to 50/60 frames per second.
b) Baseline Profile H.264 encoding with motion estimation in up to 50/60 frames per second.
c) Main Profile H.264 encoding with motion estimation and context-adaptive binary arithmetic coding (CABAC) in up to 50/60 frames per second.
d) High Profile H.264 encoding with motion estimation up to 50/60 frames per second.

6) The camera shall in H.264 | H.265 support combining Average Bit Rate (ABR) and Maximum Bit Rate (MBR)
7) The camera shall be able to deliver predictable storage using Average Bit Rate (ABR) bitrate controlling algorithm based on a bitrate budget and selected retention time.

a) The camera shall be able to deliver predictable storage using Average Bit Rate (ABR) bitrate controlling algorithm based on a bitrate budget and the selected retention time.

b) The ABR bitrate algorithm, depending on the bitrate budget and the selected retention time, shall adjust the bitrate to meet the bitrate budget over the whole retention time.

c) The ABR algorithm shall have a method to keep the video quality even during busy periods by allowing the current bitrate to be significantly above the configured average bitrate during significant parts of the retention time.

8) The camera shall in H.264 | H.265 support flexible retention period for Average Bit Rate (ABR) algorithm up to 1 year.
9) When using Average Bit Rate (ABR) the camera shall keep bitrate history up to at least 30 days.
10) The camera shall in H.264 | H.265 support reuse of past Average Bit Rate (ABR) history if a stream is disconnected and the camera reconnects with the same basic stream parameters.
11) When using Average Bit Rate (ABR), the camera shall in H.264 | H.265 support multiple parallel stream with independent ABR-history.

12) The camera shall issue bitrate degradation events when using Average Bit Rate (ABR) if the configuration is predicted to be

a) unrealistic
b) not fulfilling basic quality requirements
c) not fulfilling the bitrate budget.

13) The camera shall support scene adaptive bitrate control with one of the following capabilities to lower bandwidth and storage:

a) Automatic dynamic Region of Interest to reduce bitrate in unprioritized regions in order to lowering bandwidth and storage requirements.
b) Automatic dynamic Group of Pictures to lower bandwidth and storage requirements
c) Automatic dynamic Frames per Second to lower bandwidth and storage requirements

d. Transmission

1) The camera shall allow for video to be transported over:

d) HTTP (Unicast)
e) HTTPS (Unicast)
f) RTP (Unicast & Multicast)
g) RTP over RTSP (Unicast)
h) RTP over RTSP over HTTP (Unicast)
i) SRTP (Unicast & Multicast)

2) The camera shall support Quality of Service (QoS) to be able to prioritize traffic.

e. Image

1) The camera shall incorporate automatic and manual white balance.
2) The camera shall incorporate an electronic shutter operating in the range of 1/66500s to 2s.
3) The camera shall incorporate capture mode with the following settings:

a) HDTV 1080p (1920x1080) with WDR: 25/30 fps (50/60 Hz)
b) HDTV 1080p (1920x1080) without WDR: Up to 50/60 fps (50/60 Hz)

4) The camera shall incorporate forensic wide dynamic range functionality providing up to 120 dB dynamic range.
5) The camera shall support manually defined values for:

a) Saturation
b) Brightness
c) Sharpness
d) Contrast

6) The camera shall incorporate a function for optimization of low light behavior at different light levels.

7) The camera shall incorporate a function to manually correct barrel distortion, by using a slider to correct distortion in the image.
8) The camera shall allow for rotation of the image in steps of 180º.
9) The camera shall incorporate a function for Electronic Image Stabilization (EIS) for real-time image stabilization.
10) The camera shall incorporate automatic defog functionality.

f. Audio

1) The camera shall meet or exceed the following audio specifications:

a) The camera shall support audio simplex, with input sources
b) External microphone
c) External line device

2) The camera shall support automatic gain control.
3) Encoding

a) The camera shall support:

i. AAC LC at 8/16/32/48 kHz
ii. 24–bit LPCM 48 kHz
iii. G.711 PCM at 8 kHz
iv. G.726 ADPCM at 8 kHz
v. Opus at 8/16/48kHz

4) IR Illumination

a) The camera shall be equipped with built-in IR LEDs with a wavelength of 850 nm and with adjustable angle of illumination and intensity. Range of reach up to 40 m (131 ft) in wide field of view and 50 m (164 ft) in full tele view, or more depending on the scene.

g. User Interface

1) Web server

a) The camera shall contain a built-in web server making video and configuration available to multiple clients in a standard operating system and browser environment using HTTP, without the need for additional software.

2) Optional components downloaded from the camera for specific tasks shall be signed by an organization providing digital trust services.

3) Language Specification

a) The camera shall provide a function for altering the language of the user interface, and shall include support for at least 10 different languages.

4) IP addresses

a) The camera shall support both fixed IP addresses and dynamically assigned IP addresses provided by a Dynamic Host Control Protocol (DHCP) server.
b) The camera shall allow for automatic detection of the camera based on UPnP and Bonjour when using a computer with an operating system supporting this feature.
c) The camera shall provide support for both IPv4 and IPv6.
d) The camera shall provide support for IPv6 USGv6.

5) PTZ functionality

a) Provide digital PTZ functionality.
b) Provide preset positions functionality.
c) Provide optical zoom functionality:

i. Optical zoom: 8x

h. Event functionality
1) The camera shall be equipped with an integrated event functionality:
i. Audio
ii. Device status
iii. Temperature
iv. IP address
v. Network
vi. Shock detection
vii. System ready
viii. Edge storage
ix. I/O
x. PTZ
xi. Malfunctioning
xii. Movement
xiii. Preset position
xiv. Ready
xv. Scheduled and recurring
xvi. Video
xvii. Day-night mode
xviii. Live stream open
xix. Tampering
2) Response to triggers shall include event actions:
i. Day-night mode
ii. Defog
iii. Guard tours
iv. I/O
v. Send images, using FTP, HTTP, HTTPS, SFTP, email or network share
vi. IR illumination
vii. Send notification, using HTTP, HTTPS, TCP and email
viii. Overlay text

ix. Prset positions
x. Prioritized text
xi. Recordings
xii. Send SNMP trap messages
xiii. Send video clip, using FTP, HTTP, HTTPS, SFTP, email or network share
xiv. WDR mode

3) The camera shall provide memory for pre- and post-alarm recordings.

i. Edge storage
1) The camera shall support continuous and event controlled recording to:
i. Local memory added to the cameras microSD-card slot
ii. Network attached storage, located on the local network
2) The camera shall incorporate encryption functionality for the SD card.
3) The camera shall be able to detect and notify edge storage disruptions.

j. Protocol
1) The camera shall incorporate support for at least IPv4, IPv6 USGv6, ICMPv4/ICMPv6, HTTP, HTTPS, HTTP/2, TLS, QoS Layer 3 DiffServ, FTP, SFTP, CIFS/SMB, SMTP, mDNS (Bonjour), UPnP® , SNMP v1/v2c/v3 (MIB-II), DNS/DNSv6, DDNS, NTP, RTSP, RTP, SRTP, TCP, UDP, IGMPv1/v2/v3, RTCP, DHCPv4/v6, SOCKS, SSH, LLDP, CDP, MQTT v3.1.1, Syslog, Link-Local address (ZeroConf).
2) The SMTP implementation shall include support for SMTP authentication.

k. Text overlay
1) The camera shall:
i. Provide embedded on-screen text with support for date & time, and a customer-specific text, camera name, of at least 45 ASCII characters.
ii. Provide the possibility to choose different font sizes for embedded on-screen text, and to use white or black text on at least four different backgrounds.
iii. Provide the ability to manually set up and configure privacy masks to the image.
iv. Allow for the overlay of a graphical image, such as a logotype, into the image.

l. Security
1) The camera shall support the following:
i. Secure web browsing
ii. The use of HTTPS and SSL/TLS, providing the ability to upload signed certificates to encrypt and secure authentication and communication of both administration data and video streams.
iii. Restrict access to the built-in web server by usernames and passwords at three different levels.
iv. Certificate management
v. Provide centralized certificate management, with both pre-installed CA certificates and the ability to upload additional CA certificates. The certificates shall be signed by an organization providing digital trust services.
vi. Enhanced security features
vii. The use of signed firmware validates the firmware’s integrity before accepting to install it.

viii. The use of a secure boot process, based on the use of signed firmware, ensures that the camera can boot only with authorized firmware.
ix. Authentication
x. IEEE 802.1x (EAP-TLS) authentication.
xi. Restrict access to pre-defined IP addresses, commonly known as IP address filtering.
xii. Brute force delay protection

m. API support
1) The camera shall be fully supported by an open and published API (Application Programmers Interface), which shall provide necessary information for integration of functionality into third-party applications.
2) The camera shall conform to ONVIF profile G as defined by the ONVIF Organization.
3) The camera shall conform to ONVIF profile M as defined by the ONVIF Organization.
4) The camera shall conform to ONVIF profile S as defined by the ONVIF Organization.
5) The camera shall conform to ONVIF profile T as defined by the ONVIF Organization.

n. Embedded applications
1) The camera shall provide a platform allowing the upload of third-party applications into the camera.
2) The camera shall provide a license plate capture assistant.
i. Detection range
ii. Day: 20–100 m (66–328 ft)
iii. Night: 20–50 m (66–164 ft), up to 100 m (328 ft) with optional accessory IR-LED Illuminator
iv. Vehicle speed: up to 130 km/h (81 mph)
v. Coverage
vi. Single lane with optional edge analytics
vii. Two lanes with server based analytics

o. Installation and maintenance
1) The camera shall be supplied with Windows-based management software which allows the assignment of IP addresses, upgrade of firmware and backup of the cameras' configuration.
2) The camera shall support the use of SNMP-based management tools according to SNMP v1, 2c & 3 / MIB-II.
3) The camera shall allow updates of the software (firmware) over the network, using FTP or HTTP.
4) The camera shall provide the ability to apply a rectangle of customer-defined number of pixels to the image, which can be used as a pixel counter identifying the size of objects in number of pixels.
5) The camera shall accept external time synchronization from an NTP (Network Time Protocol) server.

6) The camera shall provide a built-in licence plate capture assistant that optimizes video settings based on mounting height, distance to vehicle, and expected vehicle speed.
7) The camera shall provide remote zoom functionality.
8) The camera shall provide autorotation functionality.
9) The camera shall detect tilt and roll angle automatically.

p. Access log
1) The camera shall provide a log file, containing information about the 250 latest connections and access attempts since the unit's latest restart. The file shall include information about the connecting IP addresses and the time of connecting.
2) The camera shall provide a connection list of all currently connected viewers. The file shall include information about connecting IP address, time of connecting and the type of stream accessed.

q. Camera diagnostics
1) The camera shall be equipped with LEDs, capable of providing visible status information. LEDs shall indicate the camera's operational status and provide information about power, communication with receiver, the network status and the camera status.
2) The camera shall be monitored by a Watchdog functionality, which shall automatically re-initiate processes or restart the unit if a malfunction is detected.
3) The camera shall send a notification when the unit has rebooted and all services are initialized.

r. Hardware interfaces
1) Network interface
i. The camera shall be equipped with one 10BASE-T/100BASE-TX Ethernet-port using a RJ45 connector and shall support auto negotiation of network speed (100 MBit/s and 10 MBit/s) and transfer mode (full and half duplex).
2) Inputs/Outputs
i. The camera shall be equipped with two configurable I/O ports, accessible via a removable terminal block. These inputs/outputs shall be configurable to respond to normally open (NO) or normally closed (NC) dry contacts. The output shall be able to provide 12 V DC, 50 mA.
3) Audio
i. The camera shall be equipped with one 3.5 mm jack for line/mic input.
4) Power
i. The camera shall be equipped with a DC power connector.
5) Other
i. The camera shall be equipped with an IDC punchdown connector

s. Enclosure
1) T`he camera shall:
i. Be manufactured with an IP66/67, NEMA250 4X rated, IK10 impact-resistant aluminum enclosure.
ii. Be fitted with a dehumidifying membrane.
iii. Be manufactured with IK08 impact-resistant glass front window.

iv. Be fitted with a weather shield with black anti-glare coating.

t. Power
   1) The camera shall provide power over Ethernet IEEE 802.3af/802.3at Type 1 Class 3
      i. Max: 12.95 W
      ii. Typical: 7.7 W
   2) 20-28 V DC
      i. Max: 13.5 W
      ii. Typical: 7.8 W
   3) 20-24 V AC
      i. Max: 20.0 V A
      ii. Typical: 12.4 V A

u. Environmental
   1) The camera shall:
      i. Operate in a temperature range of -40 ºC to +60 ºC (-40 ºF to 140 ºF)

4. Operate in a humidity range of 10–100% RH (condensing).

2.43 CAMERAS SET-UP AND CONFIGURATION

G. Closed-circuit television cameras shall conform to NTSC. The Contractor shall provide CCTV cameras in accordance with the "CCTV Camera Matrix", drawing which specifies locations, lenses, power requirements, mount type, installation details, and selected applicable sections of this specification.

H. Camera Field of View: The field of view shall be set by the Contractor to produce full view of Field of View. Follow the project construction drawings for design intent. Lack of coverage in accordance with the contractors proposed solution must be proposed with contractor bid documents. Failure to clearly annotate this notice within bid documents proposal mean contractor will provide all required coverage at the specified resolution as shown on the contract documents. The contractor may add or delete cameras where required to provide the required coverage and resolution. Adding or deleting infrastructure may also be in order. Infrastructure may not be reduce on Network Attached Storage in lieu of on board camera recording.

I. Camera Lenses: Camera lenses shall be of the type supplied with the camera from the manufacture. The lens shall be equipped with an auto-iris mechanism unless otherwise specified. Lenses having auto-iris, manual-iris and focus functions shall be supplied with connectors, wiring, receiver/drivers, and controls as needed to operate the lens functions. Lenses shall have sufficient circle of illumination to cover the image sensor evenly. Lenses shall not be used on a camera with an image format larger than the lens is designed to cover. Lenses shall be provided with pre-set capability.

2.44 VIDEO SERVER /STORAGE ENCLOSURE

A. Refer to Division 27

2.45 VIDEO MONITORING CLIENT

A. Refer to Section 28 05 31.10

2.46 SIGNAL TRANSMISSION COMPONENTS

A. Comply with requirements in Section 280513 "Conductors and Cables for Electronic Safety and Security."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine pathway elements intended for cables. Check raceways and other elements for compliance with space allocations, installation tolerance, hazards to camera installation, and other conditions affecting installation.

B. Examine roughing-in for LAN, WAN, and IP network before device installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 WIRING

A. Retain one of first two paragraphs below. Delete both if wiring method is indicated on Drawings.

B. Comply with requirements in Section 260533 "Raceways and Boxes for Electrical Systems."

C. Wiring Method: Install cables in raceways unless otherwise indicated.

1. Retain one or both of first two subparagraphs below to make exceptions to the wiring method specified above.
2. Except raceways are not required in accessible indoor ceiling spaces and attics.
3. Except raceways are not required in hollow gypsum board partitions.
4. Conceal raceways and wiring except in unfinished spaces.

D. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.

E. Splices, Taps, and Terminations: For power and control wiring, use numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.

F. For LAN connection and fiber-optic and copper communication wiring, comply with Section 271300 "Communications Backbone Cabling" and Section 271500 "Communications Horizontal Cabling."

G. Retain paragraph below only if required by manufacturer. Show independent-signal circuit-grounding methods and details on Drawings.

H. Grounding: Provide independent-signal circuit grounding recommended in writing by manufacturer.

3.3 VIDEO SURVEILLANCE SYSTEM INSTALLATION

A. Install cameras level and plumb.

B. Coordinate first paragraph below with Drawings.

C. Install cameras with 84-inch- (2134-mm-) minimum clear space below cameras and their mountings. Change type of mounting to achieve required clearance.

D. Set pan unit and pan-and-tilt unit stops to suit final camera position and to obtain the field of view required for camera. Connect all controls and alarms, and adjust.

E. Install power supplies and other auxiliary components at control stations unless otherwise indicated.

F. Retain first paragraph below if not indicated on Drawings, or coordinate with Drawings, schedules, and other Sections. Indicate which components are to be fitted with tamper switches and which Section covers tamper-switch connection.

G. Install tamper switches on components indicated to receive tamper switches, arranged to detect unauthorized entry into system-component enclosures and mounted in self-protected, inconspicuous positions.

H. Identify system components, wiring, cabling, and terminals according to Section 260553 "Identification for Electrical Systems."

3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

B. Retain first paragraph below to require Contractor to perform tests and inspections.

C. Perform tests and inspections.

1. Retain subparagraph below to require a factory-authorized service representative to assist Contractor with inspections, tests, and adjustments.
2. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
3. Inspection: Verify that units and controls are properly installed, connected, and labeled, and that interconnecting wires and terminals are identified.
4. Pretesting: Align and adjust system and pretest components, wiring, and functions to verify that they comply with specified requirements. Conduct tests at varying lighting levels,

including day and night scenes as applicable. Prepare video-surveillance equipment for acceptance and operational testing as follows:

5. Prepare equipment list described in "Informational Submittals" Article.
6. Verify operation of auto-iris lenses.
7. Set back-focus of fixed focal length lenses. At focus set to infinity, simulate nighttime lighting conditions by using a dark glass filter of a density that produces a clear image. Adjust until image is in focus with and without the filter.
8. Set back-focus of zoom lenses. At focus set to infinity, simulate nighttime lighting conditions by using a dark glass filter of a density that produces a clear image. Additionally, set zoom to full wide angle and aim camera at an object 50 to 75 feet (17 to 23 m) away. Adjust until image is in focus from full wide angle to full telephoto, with the filter in place.
9. Set and name all preset positions; consult COR.
10. Set sensitivity of motion detection.
11. Connect and verify responses to alarms.
12. Verify operation of control-station equipment.
13. Test Schedule: Schedule tests after pretesting has been successfully completed and system has been in normal functional operation for at least 14 days. Provide a minimum of 10 days' notice of test schedule.
14. Operational Tests: Perform operational system tests to verify that system complies with Specifications. Include all modes of system operation. Test equipment for proper operation in all functional modes.
15. Video surveillance system will be considered defective if it does not pass tests and inspections.
16. Prepare test and inspection reports.

3.5 ADJUSTING

B. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose. Tasks shall include, but are not limited to, the following:

1. Check cable connections.
2. Check proper operation of cameras and lenses. Verify operation of auto-iris lenses and adjust back-focus as needed.
3. Adjust all preset positions; consult COR.
4. Provide a written report of adjustments and recommendations.

3.6 CLEANING

A. Clean installed items using methods and materials recommended in writing by manufacturer.

B. Clean video-surveillance-system components, including camera-housing windows, lenses, and monitor screens.

3.7 DEMONSTRATION

A. Train personnel to adjust, operate, and maintain video-surveillance equipment.

END OF SECTION

This page is intentionally left blank.

SECTION 28 46 00 - ADDRESSABLE FIRE ALARM SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of contract, including General and Supplementary conditions and Division 01 specification sections, apply to work of this section.

B. Division 07 Penetration Firestopping

C. Division 08 Door Hardware

D. Division 21 Fire Suppression

E. Division 23 Heating Ventilation and Air Conditioning Monitoring & Control (HVAC)

F. Division 26, Basic Electrical Materials and Methods applies to work specified in this section.

G. Division 26 “Electrical Identification” applies to work in this section for labeling of conduit and equipment.

H. Division 28 “Smoke Management” applies to work specified in this section.

I. Division 28 Electronic Safety and Security.

J. Related work specified in other divisions of these specifications.

1. Installation of duct type smoke detectors. Control wiring from Fire Alarm Control equipment to mechanical fans, dampers, control equipment both low voltage and line voltage and all other control wiring associated with mechanical equipment.

1.2 SUMMARY

A. This specification describes an addressable Fire Detection and alarm signaling system. The control panel shall be intelligent device addressable, analog detecting, low voltage and modular, with digital communication techniques, in full compliance with all applicable codes and standards. The features and capacities described in this specification are required as a minimum for this project and shall be furnished by the contractor. This contractor shall be the Engineer of record for the Fire Detection and alarm signaling system.

B. The system shall include all required hardware, raceways, interconnecting wiring and software to accomplish the requirements of this specification and contract drawings, whether or not specifically itemized herein or on Contract Documents.

C. The system shall operate as a noncoded, continuous sounding system, which will sound alarm devise until manually silenced, as herein specified.

D. The system shall be wired as a Class X system for the system networked communication loop and Class B system for all other SLC, IDC and NAC circuits unless otherwise required to be Class A in accordance with local jurisdictional requirements.

E. The system as specified shall be supplied, installed, tested and approved by the local Authority Having Jurisdiction, and turned over to owner in an operational condition.

F. The contractor shall be capable of providing a “UL Listing Certificate” for the complete system.

G. Contractor shall adjust locations and quantities of fire alarm devices as required to comply with local codes. As minimum, an additional 10 audio/visual alarms, 20 smoke detectors, and 25 addressable interface devices shall be included in price including labor.

H. Contractor shall assume all responsibilities for obtaining a fire alarm permit.

1. Contractor / Fire Alarm Installer shall develop a submittal including plan drawings, calculations, etc. to submit to the local jurisdictional authority in order to obtain a permit.
2. Contractor / Fire Alarm Installer shall provide and apply a seal / signature to fire alarm drawings as required by the authority having jurisdiction in order to obtain a permit.

1.3 SUBMITTALS

A. Procedure - prepare and make submittals listed in accordance with Division 01, “Submittals” as required by Local Authority Having Jurisdiction.

B. Submittals shall be submitted in a three-part review process as follows:

1. Product data

    a. Include all project data as required herein.

2. Device layouts

    a. All devices in public areas shall be located on drawings with mounting height. Coordinate device locations with light fixtures, diffusers, fire protections heads, etc.
    b. Devices shall not be located on architectural feature walls.

3. Final shop drawings

    a. Include information as required herein.
    b. Final shop drawings shall be submitted after device location approval.

C. Product Data – For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and furnishings. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories. Complete manufacturer’s catalog data including supervisory power usage, alarm power usage, battery calculations, voltage drop calculations, physical dimensions, and finish and mounting requirements. The data shall include but is not limited to the following:

1. Control panels
2. Cabinets
3. Manual stations
4. Batteries
5. Battery charger
6. Smoke sensors
7. Installer’s training history
8. Visual alarms
9. Audio/visual alarms

10. Addressable interface devices
11. Central processing unit
12. Wiring conductors
13. Wire connectors
14. Thermal sensors
15. Electromagnetic door hold-open devices
16. Remote alpha numeric LCD annunciators with control capabilities.
17. Two-way voice communication system
18. Manufacturer's recommended calibrated test method for smoke sensors and smoke detectors.
19. Include Underwriters Laboratories or Factory Mutual listing cards for equipment provided.

D. Drawings

1. Detailed drawings for the fire alarm system shall consist of illustrations, schedules, performance charts, power calculations, point lists, instructions, riser diagrams, wiring diagrams, device finishes and complete detailed drawings of the fire alarm system.
2. A descriptive index of drawings in the submittal with drawings listed in sequence by drawing number.
3. A legend sheet identifying device symbols, nomenclature, and conventions used in the package.
4. Floor plans drawn to a scale not less than 1/8 inch equals 1 foot which clearly show locations of devices, equipment, risers, panels, electrical power connections, approximate location of conduit runs, and other details required to clearly describe the proposed system.
5. A ¼" scale plan view of the fire command center and security office with dimensioned layout and required clearances of all equipment therein.
6. Location of control panels, detectors, supervisory switches, manual pull stations, visual/audible alarms and electrical devices. Clearly and completely indicate the function of the control panel and devices. Indicate conduit routing and sizes, and the number of conductors contained in each. Indicate points of connection and terminals used for electrical field connections in the system, with a wiring color code. Indicate termination points of devices and indicate the interconnection of modules required for proper operation of the system. Indicate interconnection between modules and devices. Control diagrams shall be supplemented with a narrative description of the system. Point-to-point wiring diagrams shall indicate control panel wiring and make and model of devices and equipment. Signal circuit diagrams shall show current draw and load by device and by circuit.
7. Coordination Drawings: reflected ceiling plans and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:

    a. Light Fixtures
    b. HVAC registers
    c. Fire protection equipment interfaces
    d. Special suppression system interfaces

8. Provide a fire alarm system function matrix as referenced by NFPA 72. Matrix shall illustrate alarm input/out events in association with initiation devices. Matrix summary shall include system supervisory and trouble output functions.

E. Power Calculations

1. Battery size shall be a minimum of 125% of the calculated requirement. Provide the following supporting information:

    a. Supervisory power requirements for all equipment.
    b. Alarm power requirements for all equipment.
    c. Power supply rating justification showing power requirements for each of the system power supplies. Power supplies shall be sized to furnish a total connected load condition, including future shell space fit-out, plus 25% spare capacity
    d. Voltage drop calculations for wiring runs demonstrating worst-case conditions.
    e. NAC circuit design shall incorporate a minimum 20% spare capacity for future expansion.

F. Field Test Reports

1. Preliminary and acceptance tests.
2. Include the control panel and initiating and indicating devices, a unique identifier for each device with an indication of test results, and signature of the factory-trained technician of the control panel manufacturer and equipment installer. With reports on preliminary tests, include printer information.

G. Record Drawings

1. Upon completion, and before final acceptance of the work, submit a complete set of CADD generated as-built drawings for the fire alarm system, including components and any other associated appurtenances. Include as-built circuit diagrams complete with conductor color codes and a listing of initiating device locations and fixing voltage for each. Submit an electronic set of all documentation. Submit as-built drawings in addition to the record drawings required by Division 01, “Operation and Maintenance Data”.
2. List of FACP alphanumeric address names
3. Request for formal inspection and tests
4. When tests have been completed and corrections made, submit a signed, dated certificate with a request for formal inspection and tests.
5. Software operating and upgrade manuals.
6. Program software backup, complete with data files.

H. Operation and Maintenance Manuals

1. Fire alarm control panel
2. Smoke and thermal sensors
3. Interface and control modules
4. Submit in accordance with Division 01, “Operation and Maintenance Data”. Include current unit prices and source of supply for parts list, and a list of parts recommended by the manufacturer to be replaced after one year and three years of service. Include in the fire alarm control panel, full and comprehensive manufacturer’s repair and service manuals.

1.4 QUALITY ASSURANCE

A. Qualifications the manufacturer's authorized distributor must substantiate that within a 50-mile radius of the job site, there is an established agency which stocks a full complement of parts and offers full service during normal working hours on all equipment to be furnished and that the agency will supply parts without delay and at a reasonable cost.

B. Qualifications of Installer: Prior to installation, submit data for approval showing that the Contractor has successfully installed fully addressable, analog intelligent interior fire alarm systems of the same type as specified herein, or that the Contractor has a firm contractual agreement with a subcontractor having such required experience. Include the names and locations of at least two installations where the Contractor or the subcontractor referred to above, has installed such systems. Indicate the type and design of each system and certify that each system has performed satisfactorily in the manner intended for a period of not less than 18 months. Submit names and phone numbers of points of contact at each site.

C. Codes and Standards: Except as modified by governing codes and where more stringent standards are specified by the contract documents, comply with the latest applicable provisions and the latest recommendations of the following:

1. National Fire Protection Association (NFPA): NFPA 70, "2011 National Electrical Code": NFPA 72, "National Fire Alarm and Signaling Code": NFPA 241, "Standard for Safeguarding Construction, Alteration and Demolition Operations": NFPA 101, "Life Safety Code": NFPA 720, "Standard for the Installation of Carbon Monoxide (CO) Detection and Warning Equipment".
2. Factory Mutual (FM): FM 37825, "1952 Approved Guide".
3. Underwriters Laboratories (UL): UL FPED, "Fire Protection Equipment Directory; UL 268, "Smoke Detectors for Fire Protective Signaling Systems;" UL 164, "Control Units for Fire Protective Signaling Systems, UL 197/ANSI, "Codes applicable to Americans with Disabilities Act Compliance", "Testing for Fire Resistive Cables" UL 2196, "Cables for Power-Limited Fire-Alarm Circuits" UL 1424.
4. Americans with Disabilities Act
5. Local and City Codes and Amendments.
6. International Building Code, IBC-2018 with local amendments.
7. International Fire Code, IFC-2018 with local amendments.

D. Federal Specifications Compliance: Comply with FED-STD-595, "Colors used in Government Procurement".

E. Guarantee - all components, parts and assemblies supplied by the manufacturer shall be guaranteed against defects in materials and workmanship for a period of 12 months upon acceptance. Warranty service shall be provided by a trained specialist of the equipment manufacturer. The specialist shall be based in a fully-staffed branch office located within 50 miles from the job site.

F. Testing - conduct a total system test for Architect/Engineer and Local Fire Department. Tests shall include as a minimum.

1. Verify operation of all manual pull stations and detectors.
2. Verify line supervision of each initiating and indicating circuit.
3. Verify the operation of each initiating circuit.
4. Verify operation of all indicating devices.
5. Verify operation of all alarm-initiated functions.

6. Perform smoke test(s) as directed by the Local Fire Department. Provide electricians, and factory representatives to perform as many tests as required to approve smoke management system. The Engineer, Owner and Architect shall be advised a minimum of five working days before each test.

G. All equipment provided as part of this section shall be the product of a single fire alarm equipment manufacturer.

H. Equipment and devices shall be from a manufacturer who has been manufacturing similar products for a minimum of 5 years. Furnish materials and equipment that are current products of one manufacturer regularly engaged in the production of such equipment.

I. Provide services of a factory trained and certified representative or technician, experienced in the installation and operation of the type of system provided. The representative shall be a minimum NICET Level 2 in Fire alarm and licensed in the State if required by law.

J. Regulatory Requirements

1. Devices and equipment for fire alarm service shall be listed by Underwriters Laboratories, Inc. and listed in UL FPKD or approved by Factory Mutual and listed in FM P7825. The omission of these terms under the description of any item of equipment described shall not be construed as waiving this requirement.

K. Requirements for Fire Protection Service

1. Equipment and material shall have been tested by Underwriters Laboratories, Inc. and listed in UL FPKD or approved by Factory Mutual and listed in FM P7825. The omission of these terms under the description of any item of equipment described shall not be construed as waiving this requirement.

L. Standard Products

1. Materials and equipment shall be standard new products of a manufacturer regularly engaged in the manufacturer of such products. Select material from one manufacturer, and not a combination of manufacturers, for any particular classification of materials.

M. Modification of References

1. In NFPA publications referred to herein, consider advisory provisions to be mandatory, as though the word “shall” had been substituted for “should” wherever it appears; interpret reference to “Authority Having Jurisdiction”.

1.5 DELIVERY, STORAGE AND HANDLING

A. Protect equipment delivered and placed in storage from the weather, humidity and temperature variation, dirt and dust, and other contaminants.

B. Do not deliver or install projects or material until spaces are enclosed and completely dry.

1.6 SPARE PARTS

A. Spare parts shall be directly interchangeable with the corresponding components of the installed system. Spare parts shall be suitably packaged and identified by nameplate, stamping or tagging. Furnish the following:

1. Four keys or tools for resetting manual systems.
2. Four keys for locks of control panels or cabinets.
3. Three (bases and heads) of each type smoke (area and duct) and thermal sensors.
4. Three of each type monitor module.
5. Three of each type control module.
6. Three fuses of each type provided. Spare fuses shall be mounted in the fuse holder located inside each control panel.
7. One of each type audio/visual device.
8. One of each type visual device.

1.7 SERVICE AGREEMENT

A. Technical Support: Beginning with Substantial Completion, provide software support for 1 year.

PART 2 - PRODUCTS

2.1 SYSTEM DESIGN

A. Acceptable Manufacturers: Refer to Section 26 05 03.

B. Scope

1. The work covered by this section of the specifications includes the furnishing of all labor, equipment, materials, and performing all operations in connection with the installation of the multiplex addressable Fire Alarm System as shown on the drawings, as hereinafter specified, and as directed by the architect/engineer.
2. The Fire Alarm System shall consist of all necessary hardware and software equipment to perform the following functions:

a. The Fire Alarm Control Panel and auxiliary power panels shall provide power, annunciation, supervision and control for the system. FACP shall be capable of calling up detailed information for each addressable notification appliances including the appliance location, status, condition, type of appliance and configured appliance settings.
b. Provide Class B initiating device circuits.
c. Provide Class A signaling line circuits for the network.
d. Fire fighters two-way Supervised Voice Communication Operations.
e. Multi-Channel one-way Supervised Automatic Voice Alarm Operations. Arrange circuit to allow individual, selective and all-call voice and visual notification by zone. Notification appliance circuits shall be zoned to correspond with the building fire barriers and other building features.
f. Each stair tower NAC shall be separately zoned.
g. Remote Manual and Automatic Control of elevators, remote monitoring of sprinkler, fire pump, and emergency power systems.

h. Interface to Division 23 smoke control equipment, including but not limit to smoke control related fan systems and smoke dampers, with appropriate outputs, control functions, verification monitoring and graphics.
i. Interface to the building network lighting control system.
j. Supervision of building bi-directional radio amplification system.
k. Interface to building security & access control systems.

3. Each item of the Fire Alarm System shall be listed as a product of a single fire alarm system manufacturer under the appropriate category by the Underwriters' Laboratories, Inc. (UL), and shall bear the "U.L." label. The Control Equipment for all Systems shall be listed under UL category UOJZ as a Single Control Unit.
4. The complete installation shall conform to the applicable sections of NFPA-72, NEC 760, Life Safety Code 101, and Local Authorities Having Jurisdiction.
5. Nodes as defined for this specification shall be intelligent, microprocessor-based devices that connect to, and handle network communications.
6. By programmable selection at each node:

   a. The specific detail information of any point connected to any node in the network may be made accessible (declared public) to the network.
   b. Points within each node shall be able to be grouped by area, type of device, type of function, or any other user selectable category, and custom labeled as a point list. A point list shall be acted upon as though it was a point for purposes of interaction with the node custom control program. Detail information shall not burden the point list messages, only the quantity and type of status shall be broadcast into the network.
   c. System software and configuration updates applied to all network nodes with single download from any node.

7. Multi-Node Networks must be capable of high bandwidth (100mbps) IP based communication.
8. Survivability: All detection and control equipment used for the function of fire smoke control system interface, in addition to meeting requirements of NFPA 70, all wiring, regardless of voltage, shall be fully enclosed within continuous raceways and be 2-hour protected.

C. Alarm System

1. Furnish and install a fully field programmable/addressable analog fire detection system. The System shall determine the number and types of modules installed, the number of analog addressable loops, and all installed devices. It shall determine the type of device and the device number. The System shall use addressable signaling line circuits and addressable indicating appliance circuits with individual device supervision and annunciation, primary and secondary supervision. Include control panels, central processing unit, microphone, signal zone selectors, manual pull stations, smoke sensors, thermal sensors, addressable input interface devices, control and isolation devices, analog/addressable loop modules, audio/visual devices, visual devices, wiring, connections to devices, outlet boxes, junction boxes, and other necessary material for a complete operating system. System shall allow for loading or editing special instructions and operation sequences as required. System shall be site programmable to accommodate and facilitate expansion or changes. System shall be capable of generating the programming necessary to establish a fully functional general alarm system upon initialization. Software operations are to be stored in a non-volatile programmable memory. Loss of primary and secondary power shall not erase the instructions stored in memory. Selective input/output control functions based on ANDing,

Oring, NOTing, timing and special coded operations shall be incorporated in the resident software programming of the system.

D. Job Site Changes

1. To accommodate and facilitate job site changes, initiating and indicating circuits shall be individually configurable on site to provide either alarm/trouble operation, alarm only, trouble only, current limited alarm, no alarm, normally closed device monitoring, a non-latching circuit or an alarm verification circuit.

E. Operations

1. Display

a. Under normal condition, front panel shall display a “SYSTEM NORMAL” or equivalent message and the current time and date.

2. Sequence of Operation

a. Operation of manual stations or activation of area smoke sensors and thermal sensors including any manual or automatic initiating device shall cause the following unless noted otherwise or as required by AHJ:

1) Annunciate device type, location by building, floor, circuit and time on FACP mounted alphanumeric annunciator and graphics panel.
2) Log into the system history archives all activity pertaining to the alarm condition.
3) Print alarm condition to system printer.
4) Trip communications dialer to alert monitoring agent/Fire Department. (Response will be required to reset FACP.)
5) Building audio/visual devices to sound, except activation of a single smoke detector shall not sound devices until a second device of any type is activated, on devices programmed for Alarm Verification. Speakers and visual devices shall be activated in the area of alarm or as required by AHJ.
6) Operate prioritized outputs to release magnetically held smoke doors throughout the building and as indicated on the contract drawings. Any designated normally locked doors shall be unlocked via an interface to the security and access control system.
7) Operate prioritized outputs to signal the elevator recall trip functions. Activation of heat detector in elevator machine room or shaft shall activate an elevator power shunt trip function.
8) Operate prioritized outputs for controlling operation of dampers and fans, as required, and integration of signal/control to all other systems.
9) Automatic Voice Evacuation Sequence shall perform as outlined below:

a) Sound a pre-announced tone followed by a field programmable digitized custom evacuation message, on the floor of alarm, the floor below and the floor above. The visual signals shall operate in a similar pattern.
b) A simultaneous message shall be delivered via all alarm speakers installed on the remaining floors indicating the requirement for occupants of these floors to remain alert for further instruction.
c) An automatic announcement or tone evacuation signal shall be capable of interruption by the operation of the system microphone to

give voice evacuation instructions overriding the pre-programmed sequences.

10) Firefighter Two-Way Voice Communication Sequence shall perform as outline below:

a) The system shall incorporate a Firefighter Two-Way Communication operation. All fire phone locations shall be connected to the Master phone, located at the fire alarm control panel. The operation shall be as follows:
b) The act of plugging a handset into an emergency jack or removal of any warden phone from its normal hook position shall cause the appropriate phone circuit LED to flash and a distinctive audible device to sound at the control panel. The subsequent selection of the indicated circuit, and picking up on the Master phone, shall silence the audible tone, and cause the flashing LED to turn steady. This action shall couple the remote phone to the Master phone to provide direct and private communication. Attempting to use a subsequent phone on the same circuit shall not activate the LED or tone for that circuit. Any new circuits activated shall, however, cause their discrete phone circuit LED and tone to activate.
c) The Two-Way Communications system shall provide the capacity to handle simultaneous use of multiple remote phones. The system shall be configured to allow for remote paging from any remote phones location via the system speakers, as manually selected at the fire alarm control panel.

11) Operate prioritized outputs to Public Address system.

3. Supervisory Conditions

a. Display the origin of the supervisory condition report at the local fire alarm control panel graphic LCD display.
b. Activate supervisory audible and dedicated visual signal. Audible signals shall be silenced from the control panel by the supervisory acknowledge switch.
c. Record within system history the initiating device and time of occurrence of the event.
d. Print supervisory condition to system printer.
e. Send the event information to the Management Station with device type and custom message.

4. Trouble Condition

a. Display the origin of the trouble condition report at the local fire alarm control panel graphic LCD display.
b. Activate trouble audible and dedicated visual signal. Audible signals shall be silenced from the control panel by the trouble acknowledge switch.
c. Trouble conditions that have been restored to normal shall be automatically removed from the trouble display queue and not require operator intervention. This feature shall not prelude the logging of trouble events to the historical file.
d. Record within system history the occurrence of the event, the time of occurrence and the device initiating the event.
e. Print supervisory condition to system printer.
f. Send the event information to the Management Station with device type and custom message.

5. System Reset

    a. “System Reset” button shall be used to return to its normal state after an alarm condition has been remedied. The display shall step the user through the reset process.
    b. Should an alarm condition continue to exist, system will remain in an abnormal state. System control relays shall not reset. The panel audible signal and the alarm LED shall be on. The display will indicate the total number of alarms and troubles present in the system along with a prompting to review the points.

6. History Logging

    a. The control panel shall have the ability to store multiple events in an event buffer. These events shall be stored in a battery-protected memory. Events shall also be printed to the alarm printer.

7. Access Levels

    a. There shall be a minimum of four access levels provided for operators and supervisors via user-defined pass codes. Changes to pass codes shall be made only by authorized personnel.
    b. Should an invalid code be entered the operator shall be notified with a message.
    c. Access to a level will only allow the operator to perform actions within that level and actions of lower levels, not higher levels.
    d. The following functions shall have access levels associated with them:

        1) System Reset
        2) Set Time/Date
        3) Manual Control
        4) On/Off/Auto Control
        5) Disable/Enable
        6) Clear Historical Log
        7) Change Alarm Verification
        8) Program Update

8. Detection Operation (Smoke Sensors)

    a. Smoke sensors shall be smoke density measuring devices having no self-contained alarm set point (fixed threshold.) The alarm decision for each sensor shall be determined by the fire alarm control panel. The control panel shall determine the condition of each sensor by comparing the sensor value to the stored values.
    b. Control panel shall maintain a moving average of the sensors’ smoke chamber value to automatically compensate (move the threshold) for dust and dirty conditions that could affect detection operations. System shall automatically maintain a constant smoke obscuration sensitivity for each sensor (via the floating threshold) by compensating for environmental factors. Smoke obscuration sensitivity shall be adjustable at least twice a day and within UL 26B window (0.5 percent to 4.0 percent) to compensate for any environment.
    c. System shall automatically indicate when an individual sensor needs cleaning. When a sensor’s percentage of compensation reaches a predetermined value, a “DIRTY SENSOR” trouble condition or similar display shall be audibly and visually indicated at the control panel for the individual sensor. Additionally, the LED on the sensor base shall glow steady giving a visible indication at the sensor location. To prevent false alarms, these “DIRTY” conditions shall in no way decrease the amount of smoke obscuration necessary for system activation.

d. Control panel shall perform an automatic self-test routine on each sensor which will functionally check sensor sensitivity electronics and ensure the accuracy of the values being transmitted to the control panel. Sensors that fail this test shall indicate a trouble condition with the sensor location at the control panel.
e. An operator at the control panel, having a proper access level, shall have the capability to manually access the following information for each initiating device:

1) Primary status
2) Device type
3) Present average value
4) Present sensitivity selected
5) Sensor range (normal, dirty, etc.)

f. An operator at the control panel, having a proper access level, shall have the capability to manually control the following for each sensor:

1) Alarm detection sensitivity values.
2) Enable or disable the point.
3) Control a sensor's relay driver output.

g. It shall be possible to program the control panel to automatically change the sensitivity settings of each sensor based on time-of-day and day-of-week (for example, to be more sensitive during unoccupied times and less sensitive during occupied periods.)
h. Control panel shall have the capability of being programmed for a pre-alarm or two-stage function. This function allows an indication to occur when, for example, a 3 percent sensor reaches a threshold of 2.5 percent smoke obscuration.
i. For increased smoke detection assurance, individually addressed smoke sensors shall be provided with field adjustable alarm verification. Only a verified alarm shall initiate the alarm sequence operation. System shall be initially set up with a 30-second verification period.

9. Detection Operation (Thermal Sensors)

a. Thermal sensors shall be combination rate-of-rise/fixed temperature sensing. The alarm decision for each sensor shall be determined by the fire alarm control panel. The control panel shall determine the condition of each sensor by comparing sensor value to stored values. Sensor shall have the ability from the control panel to adjust its temperature setting.
b. Control panel shall maintain a moving average of the sensors' heat sensing value to automatically compensate (move the threshold) for dust and dirty conditions that could affect detection operations. System shall automatically maintain a constant heat sensing sensitivity for each sensor (via the floating threshold) by compensating for environmental factors.
c. System shall automatically indicate when an individual sensor needs cleaning. When a sensor's percentage of compensation reaches a predetermined value, a "DIRTY SENSOR" trouble condition or similar display shall be audibly and visually indicated at the control panel for the individual sensor. Additionally, the LED on the sensor base shall glow steady giving a visible indication at the sensor location. To prevent false alarms, these "DIRTY" conditions shall in no way decrease the amount of heat sensing necessary for system activation.
d. Control panel shall perform an automatic self-test routine on each sensor which will functionally check sensor sensitivity electronics and ensure the accuracy of the values being transmitted to the control panel. Any sensor that fails this test shall indicate a trouble condition with the sensor location at the control panel.

e. An operator at the control panel, having a proper access level, shall have the capability to manually access the following information for each initiating device:

1) primary status
2) Device type
3) Present average value
4) Present sensitivity selected
5) Sensor range (normal, dirty, etc.)

f. An operator at the control panel, having a proper access level, shall have the capability to manually control the following for each sensor:

1) Alarm detection sensitivity values.
2) Enable or disable the point.
3) Control a sensor's relay driver output.

F. Primary Power

1. Obtain primary power 208/120 VAC 50/60hz, at the emergency panel in the electrical room location as indicated. Primary power source shall be identified FIRE ALARM SYSTEM with a red and white engraved plastic sign permanently affixed to the face of the switch. Install lock clips on circuit breakers in the "ON" position.

G. Auxiliary Power (Secondary Power)

1. Provide for system operation in the event of primary power source failure. Transfer from normal to auxiliary (secondary) power or restoration from auxiliary to normal power shall be automatic and shall not cause transmission of a false alarm.

a. Batteries

1) Provide rechargeable lead acid type with sufficient ampere-hour rating to operate the system under supervisory and trouble conditions, including audible trouble signal devices for 24 hours and audible and visual signal devices under alarm conditions for an additional 15 minutes. House batteries either within the control panel or in a separate substantial steel cabinet, and finish on inside and outside with enamel paint; equip with a non-corrosive base and cylinder lock keyed to match FACP. Separate cells to prevent contact between terminals of adjacent cells and between terminals and other metal parts. Locate cabinet to allow convenient viewing and servicing of the batteries. A separate cabinet shall have twice the volume of batteries it will contain. The battery cabinet, if provided, shall be identified FIRE ALARM SYSTEM BATTERY CABINET with a red and white engraved plastic sign permanently affixed to the face of the panel.

b. Battery Charger

1) Provide solid state automatic float type, capable of recharging completely discharged batteries to fully charged condition in 24 hours or less. Locate charger within the control panel or within the battery cabinet. Provide voltmeter and ammeter to indicate battery voltage and charging current.

H. Wiring

1. Conductors

a. Provide in accordance with NFPA 70, NFPA 72 IBC and IFC. Conductors shall be copper. Conductors for 120/208-Volt circuits shall be No. 12 AWG minimum; single conductors for low-voltage D.C. circuits shall be a minimum No. 18 AWG twisted minimum. Conductors shall be color-coded. Provide wiring in electrical metallic tubing conduit in dry locations not enclosed in concrete or where not subject to mechanical damage. Conceal conduit in finished areas. Identify conductors within each enclosure where a tap, splice, or termination is made. Identify conductors by plastic-coated, self-sticking, printed markers or by heat-shrink type sleeves. Wire the alarm initiating and notification signal devices so that removal will cause the system trouble device to sound. Each conductor used for the same specific function shall be distinctively color-coded. Use two different color codes for each interior alarm circuit; one for each loop. Each circuit color code wire shall remain uniform throughout circuit. Plenum rated cable can be used where approved by engineer and is concealed but accessible.

2. Terminations

a. Connections, junctions and conductor terminations shall be made with screw terminals at risers only. Terminate strips everywhere except in control panels. Terminations with operating voltage of 50-Volts or more shall be provided with protective cover and shall be labeled with the voltage.

2.2 COMPONENT DESIGN

A. Colors

1. Provide finish colors under this section in accordance with FED-STD-595.

B. Fire Alarm Control Panel (FACP)

1. Requirements

a. FACP shall comply with the applicable requirements of UL 864 10th Edition. Panel shall be modular, installed in a surface-mounted steel cabinet with cylinder lock. The door shall be hinged to allow access for service. Control panel shall be a neat, compact assembly containing components and equipment required to provide the specified operating and supervisory functions of the system. Control panel switches shall be within the locked cabinet. A suitable means shall be provided for testing the control panel visual indicating devices (meter or lamps.) Meter and lamps shall be plainly visible when the cabinet of the control unit is closed. Each initiating circuit shall be powered and supervised so that a signal on one zone does not prevent the receipt of signals from other zones. Loss of power, including any batteries, shall not require the reloading of a program from any source. Upon restoration of power, start-up shall be immediate, automatic and shall not require manual operation. Loss of primary power or the sequence of applying primary or emergency power shall not affect the transmission of alarm, supervisory or trouble signals. Enclosures shall be provided with ample gutter space to allow proper clearance between the enclosure and live parts of the panel equipment.

b. Each FACP shall be intelligent, with its own microprocessor and memory. Each FACP shall be UL listed independently as a fire alarm control unit. Each FACP shall be capable of automatically updating the initial System Program to accommodate added or deleted devices on any analog circuit. Each FACP shall be capable of identifying and programming a General Alarm condition for all installed devices. The system shall be capable of identifying the number of analog addressable circuits, the number of devices on all circuits, the device type and location. The System shall be capable of incorporating all new devices into the System program. System shall display at the control panel, the sensitivity of remote addressable photoelectric or ionization smoke sensor devices and thermal heat sensor devices. The system shall be capable of displaying 160 characters of system and user text (4x40 alphanumeric display). Control panel shall automatically return the normal mode after a predetermined time (1 hour) after being in the service mode. Addressable devices shall be individually identified by the system, and any quantity of addressable devices shall be in alarm at any time up to the total number connected to the system. Control panel shall be capable of supporting non-addressable as well as addressable devices. The Control panel shall be capable of supporting conventional zones in addition to analog/addressable circuits. The Control Panel shall provide for addressable remote conventional zones that are hardwired to any device addressability as well as remote sensitivity measurement shall be performed on the same pair or wires. System shall be capable of having multiple addressable devices in alarm simultaneously. FACP shall have a service mode to permit the arming and disarming of individual detection or output devices as well as manually operating output devices. Status of these devices shall be displayed upon command from the FACP. Control panel shall automatically return to normal mode in the event the panel remains unattended in the service mode. Control panel shall be able to receive and process alarms even in the service mode. FACP shall be capable of:

1) Smart Start auto initialization.
2) Smart Start Program Update.
3) Program all functions from the FACP front panel.
4) Counting the number of addressable devices within a “circuit” which are in alarm.
5) Counting “circuits” which are in alarm.
6) Counting number of addressable devices which are in alarm on system.
7) Differentiating among types of addressable devices such as ionization smoke sensors, photoelectric smoke sensors, thermal heat sensors, control elements, collective zone interfaces, point identification devices, and manual stations.
8) Assigning priorities to type of detectors, circuits or groups of detectors.
9) Provide remote serial alpha numeric LCD display for all remote annunciator locations.
10) Indicate on FACP alphanumeric display, as a minimum, the following: Building Number, Floor, Type of Device, and Device Address.
11) Supporting 2500 addressable devices.
12) Provide Fireman’s Override Control Panel as required by IBC, to override control of air handling equipment, dampers and smoke control devices as required. This panel shall comply with the requirements of U.L. smoke control listing.
13) Automatic evacuation voice message which operates as a multi-channel system, allowing evacuation tones and voice messages be transmitted simultaneously to different zones. Visual alarms shall operate in unison with voice alarm system.

2. The system shall be compliant with requirement of NFPA 720 as a Carbon Monoxide Detector Control Unit and shall meet UL 2075 listing requirements. all inputs from CO sensor shall be indicated visually and audibly at the control panel. CO sensor inputs shall be distinct and descriptively annunciated from other signals.
3. The system modules shall communicate with an RS485 network communication protocol. All module wiring shall be to terminal blocks, which shall plug into the system card cage.
4. Logic

    a. The fire alarm system shall support generic functions that deal with binary states (True/False, high/low), and produce desired outputs from one or more binary inputs (for example, alarm outputs from spot detectors, VESDA detectors, monitor modules or manual station inputs). AND, OR, NOT, Any N, D Latch, RS Latch, Time Base Control, Start Timer, Restart Timer are generic functions. Generic functions can be used as inputs to other function.

5. Supervision

    a. FACP shall supervise each individual device on an initiating circuit such that trouble supervisory, normal, pre-alarm and alarm thresholds are individually annunciated. Each device on an addressable initiating circuit shall be checked to include the following: Sensitivity, response, opens, shorts, ground faults, functionality and status.

6. Reporting a Failure

    a. FACP shall report the failure of a device’s transmitting components, open or shorted, on an addressable initiating circuit. Device shall be recognized and identified by location within the circuit to the specific devices, and other devices on the circuit shall continue to function properly.

7. Devices

    a. FACP shall report by specific device and address, any device which has been removed from an addressable initiating circuit and shall not disrupt the operation of the remaining devices to function. The system shall be capable of sounding a Trouble if the device replaced is a different device type than the device removed.

8. Accessories

    a. FACP shall be completely equipped and be provided with 25 percent spare initiating and indicating circuits, including modules, enclosure space, terminal strips, internal electronic memory and other necessary accessories complete and ready to accept future circuits. The FACP shall be capable of automatically updating the System Program to adjust for such changes.

9. Power

    a. FACP shall provide power necessary for the devices connected to it, including relay and remote annunciators. Provide a green LED to indicate normal system power is functioning.

10. Hardware and Software

    a. Hardware and software which define system configuration and operation shall be provided. Memory data and operating system software shall be contained in a non-volatile memory.

11. Smoke Sensors

    a. Smoke sensors shall be provided with alarm verification with field-adjustable time from 0 to 60 seconds. System shall initially set up with a 30-second verification period.

12. Detector Sensitivity

    a. FACP shall be capable of measuring and adjusting the sensitivity of sensors. Provide an alphanumeric display to display custom messages and give readings of sensor sensitivity, sensor by sensor. It shall not be possible to change the sensor sensitivity from the FACP within maximum and minimum values as defined by the UL listing of the sensors. System shall be capable of listing sensor sensitivity settings on the printer for permanent record.

13. Self-Test Routine

    a. Control panel shall continuously perform an automatic self-test routine on each sensor which will functionally check sensor sensitivity and ensure the accuracy of the values being transmitted to the control panel. Any sensor that fails this test shall indicate a trouble condition with the sensor location at the control panel.

14. Resetting and Testing the System

    a. It shall be possible to test, reset and alarm silence from the FACP. New unacknowledged alarms and troubles shall be distinctively displayed on both the visual display and the printer and differentiated from previous alarm and troubles. System shall automatically indicate the total quantity of alarms and trouble which have occurred prior to reset at the control unit. No alarm or trouble indication shall be resettable until it has been acknowledged. It shall not be possible to reset the system until alarms have been acknowledged.

15. FACP Switches

    a. FACP switches shall allow authorized personnel to accomplish the following, independent of the main operating console:

        1) Trouble silencing switch which transfers trouble signals to an indicating lamp.
        2) Evacuation alarm silencing switch which, when activated during alarm, silences alarm devices and, upon clearing the alarm, causes operation of the system trouble signals until the switch is returned to the normal position. Upon activation of a second alarm while silenced, causes the evacuation alarm to re-sound. Operation of the switch when there is no evacuation alarm causes operation of the system trouble signals.
        3) Reset zones after initiating devices have been returned to normal.
        4) Perform a complete operation test of the microprocessor with a visual indication of satisfactory communications with each board.

5) Test panel LEDs for proper operation without causing a change in the condition on any zone.

16. Field Programming Equipment

a. Provide field programming equipment, software devices, software, computers and other equipment necessary, including interconnection cables to accommodate field software programming changes to be made by the owner to change device descriptions, sensitivity setting, control, device type and addition or deletion of devices.

17. Management Station

a. A Management Station shall be a PC based, display and software package UL listed for this application. The Management Station shall have as a minimum, the following:

1) Intuitive graphic user interface.
2) Global and local command abilities.
3) Time-based control for entire system.
4) SVGA graphics support.
5) Event display by color and icon.
6) Full touch screen support.
7) Integration with building management station.
8) Provide a UPS with minimum 1-hour full speed operating capacity (including any required Network repeaters) for each workstation.
9) Printers: Each workstation shall have one (1) printer.
10) Printer shall be dedicated to FA System alarms and shall be provided with a minimum 1-hour UPS.

18. Lockable Equipment

a. Lockable equipment shall have a keyed lock. All devices and cabinets shall be keyed alike.

19. Networking

a. Digital communication capabilities using either DC digital or fiber optic technologies or combinations of both as required for the control panel to communicated with remote transponders or network nodes.
b. Capability shall exist within the system to extend the network at any node.

C. System Enclosure

1. Enclosure needed to hold all the cards and modules as specified with at least spare capacity for extra cards. The enclosure outer door shall be either black or red. Provide the color as to the local AHJ requirements. The outer doors shall be capable of being a left hand open or a right hand open.
2. Provide system enclosure for all amplifiers. Where required by the manufacturer, provide means for venting heat from the enclosure either by having enclosure sides and top vented or the doors vented.

D. System Printer

1. The logging printer shall be UL listed with the system. This parallel printer shall be supervised for: online/offline, out of paper, paper jam, power off and system connection. The printer shall be a: high speed, 24 dot matrix, wide carriage, and capable of using tractor or friction fed paper. Supervised network connection shall be either Style 4 or 7 as required by local requirements.

E. Manual Stations

1. Provide an addressable noncoded double action type with mechanical reset features. Locate stations as indicated. Stations shall be die cast aluminum semi-flush or surface-mounted. Surface-mounted boxes shall be painted the same color as alarm station.
2. Mount stations with the base at 4 feet above finished floor and no more than 5 feet from any door, measured horizontally, as shown.
3. Provide each station with screw-type terminals of proper number and type to perform functions required. Break-glass-front stations will not be permitted; however, a pull-lever, break-glass-rod type is acceptable.
4. The manual alarm station shall require a key to reset or test.

F. Smoke Detectors

1. Provide analog addressable smoke detectors of the photoelectric type which shall communicate actual smoke chamber values to the system fire alarm control panel. Detectors shall be uniquely identifiable to FACP.
2. Detectors shall be listed to UL 268, 7th Edition and shall be documented compatible with the control equipment to which they are connected. Detectors shall be listed for both ceiling and wall-mount applications.
3. Detector shall be UL listed for operation in a 95% relative humidity (RH) environment.
4. Each detector base shall contain a LED that, when the control panel determines that a detector is in the alarm or trouble condition, the control panel shall command the LED on that detector's base to turn on steady, indicating the abnormal condition.
5. Detector's electronics shall be immune from false alarms caused by electromagnetic interference and radio frequency interference.
6. All detector addressing information shall be stored in the fixed base. Addressing information that is stored in the removable detector is not acceptable.
7. Where required, the detectors shall incorporate an addressable Carbon Monoxide (CO) sensor. The CO sensor shall be selectable as an input to the multi-criteria fire detector algorithm and as an independent life-safety CO gas detector, in compliance with NFPA 720. The multi-criteria detector with CO input shall be UL 2075 compliant as a gas and vapor detector.
8. The multi-criteria detector with CO sensor shall support the use of an ambient Carbon Monoxide warning signal at the panel. This ambient CO level shall be user configurable in parts per million (PPM) for the set threshold of the warning and event type generated by the warning. This event can be used to trigger system logic.

G. Duct Smoke Detectors

1. Detectors in duct shall be analog addressable photoelectric type and listed by UL or FM for duct installation.
2. Duct detectors shall be provided with approved duct housing, mounted exterior to the duct, and shall be provided with perforated sampling tubes extending across the width of the duct. Where duct detectors are exposed to the weather a weatherproof enclosure shall be available.

3. Activation of duct detectors shall cause actuation of the fire alarm control panel in the same manner as other supervisory initiating devices and in addition, cause all air handling units to be deactivated.
4. Detector to be provided with indicating lamp and test switch and in test position bypass fan shutdown feature.

H. Heat Detectors

1. Provide analog addressable heat detectors of the combination rate-of-rise and fixed temperature type which shall communicate actual heat values to the system fire alarm control panel. Detector temperature setting shall be accomplished via the FACP. Detectors shall be uniquely identifiable to FACP.
2. Detectors shall be listed to UL 521 and shall be documented compatible with the control equipment to which they are connected. Detectors shall be listed for ceiling applications.
3. Each detector base shall contain an LED that, when the control panel determines that a detector is in the alarm or trouble condition, the control panel shall command the LED on that detector's base to turn on steady, indicating the abnormal condition.
4. Detector's electronics shall be immune from false alarms caused by electromagnetic interference and radio frequency interference.
5. Detectors shall be nominal 24 Vdc powered by initiating circuit.

I. Beam Smoke Detector

1. Beam type smoke detector shall be supplied at the locations shown on the drawings. The beam smoke detector shall consist of a separate transmitter and receiver capable of being powered separately or together. The detector shall operate in either a short range of 30 to 100 ft. or a long range of 100 to 300 ft. The detector shall feature a bank of alignment LEDs on both the transmitter and receiver to ensure proper alignment without the use of special tools. The detector shall utilize an automatic gain control to compensate for gradual signal deterioration from dirt accumulation on the lenses. The detectors shall be powered from the system control panel.

J. Addressable Point Identification Device

1. The Point Identification Device shall be provided to connect single supervised conventional initiating contact type device such as water flow switches, tamper switches, single detectors, and other such devices to any of the two-wire intelligent analog loop cards. The Point Identification Device shall mount in a 4-inch square, 2 1/8-inch-deep electrical box and shall be capable of (Class "A") supervised wiring to the initiating device. The Point Identification Device shall contain an integral LED that annunciates module activation. The Point Identification Device shall provide address setting means switches and store an internal identifying code which the control panel shall use to identify the type of device.

K. Addressable Collective Zone Interface

1. The Collective Zone Interface shall be provided to connect supervised conventional initiating device or zone of supervised conventional initiating devices such as water flow switches, tamper switches, detectors, and other such devices to any of the three -wire intelligent analog loop cards. The Collective Zone Interface shall mount in a 4 11/16-inch-square, 3-inch-deep electrical box and shall be capable of (Class "A") supervised wiring to the initiating device(s). The Collective Zone Interface shall contain an integral LED that annunciates module activation. The Collective Zone Interface shall provide address setting means switches and store an internal identifying code which the control panel shall use to identify the type of device.

L. Addressable Control Element

1. The Addressable Control Element shall be provided to connect and supervise, conventional indicating device or zone of indicating devices that required an external power supply, such as horns, strobes to any of the (2) wire intelligent analog loop cards. The Control Element shall be capable of operating as a relay (dry contact form C,) to control door holders, and other such devices. Control Elements shall mount in a 4 11/16-inch-square, 3-inch-deep electrical box and shall be capable of (Class “A”) supervised wiring to the indicating or control device. Control Element shall contain an integral LED that annunciates module activation. Control Element shall provide address setting means switches and store an internal identifying code which control panel shall use to identify the type of device. The addressable Control element shall be capable of providing feedback to the FACP for positive confirmation of the controlled devices activity.

M. Audio/Visual Alarms

1. Provide recessed and surface-mounted approved combination audio/visual alarm devices consisting of an electronic horn for use in an electrically-supervised circuit and a top-mounted integral flashing strobe light. The alarm horn shall have a sound rating of at least 96 decibels at 10 feet. Provide lamps of the flashing stroboscopic type, powered from the control panel alarm circuit. Lamps shall produce a minimum of 75 candela and be designed for A.D.A. compliance. Lamps shall be protected by a polycarbonate lens and shall be labeled FIRE, and are to be mounted at 80 inches above the floor, unless noted otherwise on the drawings.
2. Visual alarms shall operate in unison with audio alarm system.

N. Visual Alarms

1. Provide flush and surface-mounted lamp assembly suitable for use in an electrically-supervised circuit. Provide lamps of the flashing stroboscopic type, powered from the control panel alarm circuit. Lamps shall produce a minimum of 75 candela and be designed for A.D.A. compliance. Lamps shall be protected by a polycarbonate lens and shall be labeled FIRE, and are to be mounted at 80 inches above the floor, unless noted otherwise on the drawings.
2. Visual alarms shall operate in unison with voice alarm system.

O. Electromagnetic Door Hold-Open Devices

1. Attach to the outlet boxes indicated. Device shall operate on power from the fire alarm control panel. Attach compatible magnetic component to the door. Under normal conditions, the magnets shall attract and hold the door open. Upon activation of the building fire alarm system, the devices shall be de-energized, thus releasing the doors on the circuit. Devices shall be designed for wall or floor mounting as required by location shown on drawings, complete with matching door plate, material and finish to match door hardware. Electromagnet operates from a 24 DC source, and requires no more than 0.070 watts to develop 25 lbs. holding force.

P. Fire Alarm Speakers - High Output

1. Speaker shall be a high efficiency, re-entrant type speaker suitable for voice and tone signals. Speaker shall be able to operate continuously without loss of signal for one hour in any ambient temperature environment from 150°F to -30°F. Speaker shall have a die cast housing and be resistant to water, corrosion, vibration and vermin and shall be imperious to damage from pointed objects. Speaker shall produce a sound pressure level of 87 dB measured at rated power (1 watt) ten (10) feet on axis at 1 Khz.
2. Speakers shall be suitable for semi-flush mounting or recessed as shown on plans. All speakers shall be mounted in the ceiling in office areas.

Q. Fire Alarm Speakers - Medium Output

1. Speaker shall be a high efficiency, re-entrant type speaker suitable for voice and tone signals. Speaker shall be able to operate continuously without loss of signal for one hour in any ambient temperature environment from 150°F to -30°F. Speaker shall have a die cast housing and be resistant to water, corrosion, vibration and vermin and shall be impervious to damage from pointed objects. Speaker shall produce a sound pressure level of 87 dB measured at rated power (1 watt) ten (10) feet on axis at 1 Khz. Speakers shall have transformer taps of 2, 1, ½ and ¼ watts RMS audio power rating. Speaker shall be provided with pigtail leads for wiring terminations. Speaker shall be semi-flush mounted on a standard 4 x 4 electrical box with extension ring, or fully recessed as noted on the plans. All speakers in general space shall be medium output.
2. Where speakers are indicated to be installed flush mounted, provide with a white circular metal baffle with perforated holes meeting the Architect's approval.

R. Outdoor Fire Light and Horn

1. Outdoor fire lights and horn suitable for wet locations complete with high intensity flashing light and alarm horn as integral unit.
2. The electrical light source shall be sealed in silicone and protected by a Lexan lens. The word "fire" shall appear on the lens.
3. The minimum sound level shall be 95 dB at ten (10) feet.

S. Firefighters' Two-Way Telephone Communication

1. Dedicated two-way, supervised, telephone voice communication links between fire alarm control panel and remote fire fighters' telephone stations. Supervised telephone lines shall be connected to talk circuits by controls in a control module. The system shall include the following.

    a. Selective-talk type for use by fighters and fire wardens.
    b. Controls to disconnect phones from talk circuits if too many phones are in use simultaneously. An indicator lamp shall flash if a phone is disconnected from the talk circuits.
    c. Selector panel controls to provide simultaneous operation of up to six telephones. Indicate ground faults and opens or shorted telephone lines on the panel front by individual LEDs.
    d. Graphic digital to indicate location of caller.
    e. Remote telephone cabinet shall be flush or surface mounted cabinet, factory standard red finish.

2. Remote telephone jacks shall be single gang, stainless steel plate mounted plug, engraved "Fire Emergency Phone"

3. Portable handsets shall be push-to-talk with noise cancelling microphone, with a 5 ft coiled cord on a telephone plug. Provide six handsets stored in cabinet adjacent to fire alarm control panel in the fire command center.

T. Firefighters' Smoke Control System

1. Comply with sequence of operation as described in Section 28 31 10/23 09 03 "Smoke Management".
2. Fire alarm system shall provide all interfaces and control point required to properly activate smoke management systems.
3. First fire alarm system initiating device to go into alarm condition shall activate the smoke control functions. Subsequent devices going into alarm condition shall have no effect on the smoke control mode.

U. Remote Indicator Lights

1. Remote indicator lights shall be lighted red when the associated device is in alarm. Light shall be mounted in a stainless-steel cover plate with the appropriate legend engraved thereon. Indicators shall be a highly visible red LED.

V. Graphic Annunciator Panel

1. A hard-graphic annunciator shall be provided on each level depicting all fire alarm devices on that entire level and the status condition of each device via a led. Detector locations shall be represented by red LED lamp. Normal system operation shall be indicated by green LED lamp. Trouble and supervisory alarms shall be represented by amber LED.
2. Comply with UL 864.
3. Graphic representation of the facility shall be a CAD drawing and each detector shall be represented by an LED in is actual location. CAD drawing shall be 1/8"-1'-0" scale or larger.

W. Remote Annunciator

1. Annunciator functions shall match those of fire-alarm control unit for alarm, supervisory, and trouble indications. Manual switching functions shall match those of fire-alarm control unit, including acknowledging, silencing, resetting, and testing.
2. Display Type and Functional Performance: Alphanumeric display and LED indicating lights shall match those of fire-alarm control unit. Provide controls to acknowledge, silence, reset, and test functions for alarm, supervisory, and trouble signals.

X. Digital Communicator

1. The Multi-Point Digital Alarm Communicator shall be UL864 listed to provide point identification of alarm, supervisory and trouble events to a Central or Remote Receiving Station. The digital communicator shall support the following:

    a. Ademco Contact ID or SIA protocol
    b. Ademco Contact ID selection shall provide the ability to transmit events for up to 999 individual zones.
    c. SIA selection shall provide the ability to transmit events for up to 10000 individual points.
    d. Programming of accounts and phone numbers.
    e. Cellular connectivity.
    f. Line fault monitoring.

g. Automatic 24-hour test.
h. Supports configurable alarm, alarm restoral, trouble, trouble restoral, supervisory, supervisory restoral and reset events.
i. Supports Ademco Contact ID alarm event codes for general alarm, smoke detector alarm, waterflow alarm, duct alarm and manual alarm events.

Y. Nameplates

1. Major components of equipment shall have the manufacturer's name, address, type or style, model or serial number, catalog number, date of installations, installing Contractor's name and address, and the contract number provided on a new plate permanently affixed to the item or equipment. Major components include, but are not limited to, the following:

a. Fire Alarm Control Panels

1) Furnish to obtain approval by the Engineer/Fire Department before installation. Nameplates shall be etched metal or plastic, permanently attached by screws to panels or adjacent walls.

Z. Wiring

1. Provide Wiring materials under this section as specified in division 26, "Wires and Cables", with the addition and modifications specified herein.

PART 3 - EXECUTION

3.1 INSTALLATION

A. The work includes providing a new fully field programmable/addressable analog interior fire alarm and smoke detection system including associated equipment and appurtenances. Provide each system complete and ready for operation. Equipment, materials, installation, workmanship, inspection, and testing shall be in strict accordance with the required and advisory provisions of NFPA 70, NFPA 72 and NFPA 241, except as modified herein.

B. Provide intelligent, analog addressable type manual pull stations, smoke sensors, thermal sensors, and audio/visual devices, including a stand-alone fire alarm control panel as located on the drawings and required by the fire department.

C. Provide additional voice alarm speakers where sound level is not above 15dB above ambient noise level.

D. Pre-inspection - examine areas and conditions under which work of this section is to be performed. Do not proceed with work until unsatisfactory conditions have been corrected.

3.2 INSTALLATION CRITERIA

A. All fire alarm wiring shall be in conduit. All alarm and signal wiring shall be in accordance with the manufacturer's recommendations and installed in an approved raceway specified in Section 26 05 33. Plenum rated cable is acceptable in concealed accessible areas where installed in open cable tray systems or J-hooks.

B. Wiring integrity and survivability requirements shall be specified on shop drawings per NFPA 72, Chapter 12.

C. The contractors shall fully coordinate with all other trades for the proper wiring and control of all systems.

D. Wiring in the Fire Command Center may utilize surface-mounted wireways. Sizes and locations of such wireway shall be indicated on the shop drawings.

E. All wiring shall be identified at the Fire Command Center and at each terminal and junction box.

F. VCS speakers shall be wired in parallel.

G. Control panel, annunciators, standby power module must be mounted with sufficient clearance for observation and testing. Fasten equipment to structural members of building or metal supports attached to structure. Final arrangement and location must be approved by the Architect/Engineer and Fire Department

H. Flexible connectors are to be used for all devices mounted in suspended lay-in ceiling panels. All conduit, mounting boxes, junction boxes and panels are to be securely hung and fastened with appropriate fittings to insure positive grounding throughout the entire system. No wiring other than that directly associated with fire alarm detection, alarm or auxiliary functions will be permitted in fire alarm raceways.

I. Conductors in cabinets must be carefully formed and harnessed so that each drops off directly opposite to its terminal. Cabinet terminals must be numbered and coded.

J. Wiring splices are to be avoided to the extent possible, and, if need, they must be made using solderless connectors and only in junction boxes which are to be painted fire-alarm red.

K. Color codes must be used throughout. Transposing or changing color coding of wire will not be permitted. Wire nut-type connections are not acceptable. All conductors in conduit pull boxes or cabinets containing more than one wire must be labeled on each end with “E-Z Markers” or equivalent.

L. Provide all necessary emergency power to the complete Fire Alarm System in accordance with the manufacturer’s requirements.

3.3 PAINTING

A. Paint exposed electrical, fire alarm conduit and surface metal raceway to match adjacent finishes in exposed areas. Paint conduit and surface metal raceways red in unfinished areas and above finished ceilings.

3.4 FIELD QUALITY CONTROL

A. Preliminary Tests

1. Conduct the following tests during installation of wiring and system components. Correct any deficiencies pertaining to these requirements prior to formal functional and operational tests of the system.

2. Ground Resistance

    a. Measure the resistance of each connection to ground. Ground resistance shall not exceed 10 ohms.

3. Dielectric Strength and Insulation Resistance

    a. Test dielectric strength and the insulation resistance of system interconnecting wiring by means of an instrument capable of generating 500-Volts D.C. and equipped to indicate leakage current in 1000 mega-ohms. For the purpose of this test, instrument shall be connected between each conductor on the line and between each conductor and ground at control panel and of line, with the other extremity open circuited and series-connected devices shunted or in place. System shall withstand test without breakdown and indicate a resistance of not less than 500,000 ohms, the measurement being taken after an electrification of not more than 1.0 minute with a dc potential of not less than 100-Volts nor more than 550-Volts. Dielectric tests shall be witnessed by Engineer or their designee.

4. Smoke and Thermal Sensor Tests

    a. Prior to formal inspection and tests, clean and perform sensitivity tests on each smoke and thermal sensor. Clean the smoke and thermal sensors in accordance with the manufacturer's recommended procedures. Perform voltage activation sensitivity test on each sensor and record the results. Remove sensors with a sensitivity level above or below the UL accepted sensitivity range for that sensor and replace with new sensors. Present recorded data at the formal inspection for verification. Approved copies shall become part of the operations and maintenance manual for the fire alarm system.

5. Field Inspection and Test

    a. Before final acceptance of the work, test each system to demonstrate compliance with the contract requirement. Each system shall be subjected, at minimum, to complete functional and operational tests including tests in place of each smoke sensor and detector, each thermal sensor, each manual station and visual and audio/visual device, tests of wiring supervision and tests of control panel functions. Preliminary tests shall be performed in accordance with manufacturer's published testing instructions and in accordance with NFPA 72. Furnish one extra Operations and Maintenance Manual with the formal request for final acceptance testing. The system shall be operational, with no trouble or alarm conditions, a minimum of 14 consecutive days prior to formal tests. Printer shall be operational during the preliminary tests and break-in period. Provide printer records with the request for formal inspection as evidence of completion of required preliminary test.

6. Formal Inspection and Test

    a. The Authority Having Jurisdiction will witness formal tests after receipt of written certification that preliminary tests have been completed and that the system is ready for final inspection. The system manufacturer's technical representative shall be present for the inspection and test. At minimum, preliminary tests shall be repeated and functional and operation tests conducted, as requested by the Architect/Engineer. Correct defects and conduct additional tests to demonstrate that the system conforms to contract specifications. Contractor shall provide two-way radios, personnel, ladders, scaffold and test equipment required for conducting tests. Smoke detectors shall be tested using the manufacturer's calibrated test method. In addition, formal testing will require real smoke to be used to test smoke detectors. Canned smoke will not be permitted.

7. Manufacturer's Field Service

    a. Manufacturer's Representative

        1) Furnish the services of a factory-trained fire alarm system manufacturer's representative or technician, experienced in the installation and operation of the type of system being provided, to supervise the installation, testing, including formal testing, adjustment of the system, and instruction to the facility personnel. Furnish names and phone numbers of the factory-trained fire alarm system representatives or technicians.

B. Training

1. Equipment manufacturer shall provide 40 hours on site technical training to the owner or its representative (for two persons designated by Owner). Training shall allow for individual hands on programming, troubleshooting and diagnostics exercises. Training shall occur within 2 months of system acceptance.

C. Adjustments

1. Equipment manufacturer shall provide necessary subsequent custom reprogramming to modify and adjust operations and individual identification nomenclature to the owner satisfaction four months after final system acceptance and twelve months after system acceptance. Reprogramming is to be done at the job site and witnessed by the Authority Having Jurisdiction representative. Revision of as-built and record drawings shall be by the installing Contractor.

END OF SECTION

This page is intentionally left blank.

SECTION 28 46 10 - SMOKE MANAGEMENT 23 09 03 AND 28 46 10

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplemental Conditions of the Construction Contract and Division 1 Specification Sections, apply to this Section.

1.2 SUBMITTALS

A. PRELIMINARY SUBMITTAL: Prospective smoke management contractors shall submit for review by the Owner's authorized representatives a preliminary written description of his proposed smoke management systems, including block diagrams showing all major components and panels and other processing devices and required cabling between each.

1. Include manufacturer's literature for each type of panel, controller or device that may be shown on the block Diagram.
2. Block Diagram shall show, schematically, the entire building system with all major components identified.
3. Include information about proposed communications buss and data transmission, including UL listings.
4. Provide a written explanation of any characteristics, items of equipment or control intent, which differs from the requirements of this Division. Explain what, if any, alternative characteristics, items of equipment or control intent will be provided.
5. Alternate systems, characteristics, items of equipment or control intent, which do not comply with these specifications, may be rejected if not acceptable to the Engineer. Any rejected alternate system, characteristics, items of equipment or control intent shall be replaced by the specified system, characteristics, items of equipment or control intent at no extra cost to the project.

B. The following data/information shall be submitted for approval:

1. FSCS and all associated components, including panel layout.
2. Complete sequence of operation including detailed matrix.
3. Smoke control dampers, including parallel BMS and smoke control interface requirements.
4. Air piping.
5. Communications wiring including survivability and supervisory requirements.
6. Smoke control system Cad generated drawings including all pertinent data to provide a functional operating system.
7. Smoke control damper schedules showing size, configuration, capacity and location of all equipment.
8. Data sheets for all hardware and software control components.
9. A description of the installation materials including conduit, wire, flex, etc.
10. Smoke control system panel locations.

C. The smoke management contractor shall provide submitted drawings for the entire control system for review and approval before work shall begin. Included in the submittal drawings shall be a diagram depicting the system architecture complete with a communications riser. Drawings shall include point-to-point wiring diagrams and must show all controls, start-stop arrangement for each piece of equipment, equipment interlocks, wiring terminal numbers and any special connection information required for properly controlling the mechanical equipment. The submittal shall include a bill of material reference list as well as equipment sequences of operation.

D. The submittals shall include a specification compliance analysis for review and approval before work shall begin. The compliance document shall address each paragraph of this specification by indicating COMPLY, EXCEED, or EXCEPTION. Do not indicate COMPLY unless the proposed system exactly meets the paragraph requirement. If EXCEED or EXCEPTION is indicated, then provide a clear and concise explanation of the variance from the specifications and the net effect this would have on the specified system performance.

E. Wiring diagrams shall include internal wiring of all electrical control devices.

F. Submit completed computer graphics for all the equipment and building floor plans showing respective smoke control zones prior to scheduled completion of the project for approval.

1.3 STANDARDS

A. Materials shall comply with the following standards.

1. NFPA 92 (2015 Edition)
2. NFPA 70 National Electrical Code
3. NFPA 72 National Fire Alarm Code
4. NFPA 101 Life Safety Code
5. Local Code Requirements and Amendments
6. Life Safety Report as prepared by Life Safety Report by Code Consultant
7. UL 555 Standard for Safety Fire Dampers
8. UL 555S Standard for Safety Leakage Rated Dampers for Use in Smoke Control Systems
9. UL 864/UUKL

1.4 RELATED WORK

A. Section 21 13 00 – Fire Suppression Sprinkler Systems

B. Section 23 34 00 – Fans

C. Section 23 33 00 – Ductwork Accessories

D. Section 23 09 00 – Building Automation and Automatic Temperature Control Systems.

E. Section 23 05 93 – Test Adjust and Balance

F. Section 28 46 00 – Addressable Fire Alarm System

PART 2 - PRODUCTS

2.1 DESCRIPTION OF SYSTEM(S)

A. Provide a fully functioning Smoke Management System. This system shall be fully coordinated with other life-safety within the building.

B. System shall include the use of both passive (architectural) and mechanical means to remove and prevent the movement of smoke. Mechanical methods include the following:

1. Stairwell pressurization**.**
2. Zoned smoke exhaust systems.

C. The intent of the Smoke Management System is to prevent the flow of smoke into egress areas of the building, and provide a tenable environment in the areas protected for a period of time sufficient to evacuate the building. It should be noted that smoke would exist in these areas.

D. All components of the Smoke Management System shall be able to operate during a fire event for not less than 20 minutes.

2.2 FIRE FIGHTERS' SMOKE CONTROL STATION (FSCS)

A. A Fire Fighters' Smoke Control Station (FSCS) shall be provided for full monitoring and manual override and control of all devices associated with the Smoke Management System. The FSCS and all control components shall be UUKL listed.

B. The FSCS shall have the highest priority of control over all other operational states, including automatic activation of the Smoke Management System. The FSCS shall bypass all other building automation functions and local "hard-wired" controls such as Hand-Off-Auto switches, high-limit status pressure switches, freeze stats and smoke detectors.

C. The FSCS shall not bypass controls intended to provide for electrical overloads, personal safety when servicing equipment or prevent system damage.

D. The FSCS shall not bypass duct-mounted smoke detectors on supply air systems that are not part of the Smoke Management System.

E. The FSCS shall include a graphic representation of the building, the smoke zones and the Smoke Management System. Fans, dampers, ductwork and other devices shall be clearly indicated on the FSCS along with direction of airflow.

F. The status of each component shall be indicated by a pilot light according to the following legend:

1.	GREEN	-	Devices in their ON or OPEN state.
2.	WHITE	-	Devices in their NORMAL or OPERATING state.
3.	YELLOW	-	Devices in their TROUBLE or FAULT state.
4.	RED	-	Devices in their OFF or CLOSED state.

G. The FSCS shall include switches for all devices associated with the Smoke Management System as follows:

1. ON-AUTO-OFF
   Control over each device that can be controlled from other locations or systems.

2. OPEN-AUTO-CLOSED
   Control over each damper that can be controlled from other locations or systems.

3. ON-OFF or OPEN-CLOSED
   Control over each device that is solely intended for use in the Smoke Management System.

H. When a switch is in the AUTO position, other automatic or manual devices shall be allowed to control the Smoke Management device, however once a control function is issued from the FSCS, no other system or device within the building shall countermand this action.

I. When a switch is in the AUTO position, the device's status shall be indicated (ON, OFF, OPEN, CLOSED) as noted above.

J. VAV terminal units that are all located within and serve only one Smoke Management zone may be controlled collectively.

K. A push-to test switch shall be provided to test all pilot lights.

L. The FSCS shall be labeled in plain English having a font equivalent to 12-point Helvetica bold.

M. A full-scale color drawing of the FSCS shall be submitted to the Engineer and the local Authority Having Jurisdiction for review and approval.

2.3 ACTIVATION

A. The Smoke Management System shall be automatically activated by a signal from any of the following devices within the appropriate smoke zone:

1. Sprinkler waterflow in zone.

   a. Sprinkler zones must match smoke zones

2. Fire department manual controls.
3. Beam detector.
4. Area smoke detectors.
5. Heat detectors.

B. The Smoke Management System shall also be manually activated and deactivated from the FSCS.

C. Response Times:

1. The Smoke Management System shall be activated immediately upon receipt of initiation signal (manual or automatic).

a. Devices within the system shall be activated and report the desired state or operational mode to the FSCS within the following timeline:

1)	Damper closing (start)	15 Seconds
2)	Damper opening (start)	15 Seconds
3)	Completion of damper travel	60 Seconds
4)	Fan energizing (start)	15 Seconds
5)	Fan de-energizing (start)	Immediately
6)	Fan volume modulation	30 Seconds
7)	Fan at desired state	75 Seconds
8)	Pressure control modulation	15 Seconds
9)	Temperature control override	Immediately
10)	Positive indication of status	15 Seconds

11) Total response time from detection to full equipment operation shall be no more than 110 seconds.

b. Response times indicated above shall be the same whether the system has been activated manually from the FSCS or automatically from any initiation device.
c. Components shall be sequenced as necessary to avoid physical damage to components and the system.

2.4 EQUIPMENT

A. All devices associated with the Smoke Management System shall be UL listed for their application.

B. Where applicable, all devices associated with the Smoke Management System shall be designed to withstand temperatures of 250 °F.

C. Dampers:

1. All dampers used in engineered Smoke Management Systems shall be UL listed in accordance with UL 555 Standard for Safety Fire Dampers and UL 555S Standard for Safety Leakage Rated Dampers for use in Smoke Control Systems.
2. Dampers shall be minimum Class II, rated for 250°F.

D. Fans:

1. Where applicable, fans shall be designed and certified by the manufacturer to withstand temperatures of 250 °F.
2. All fans used in conjunction with the Smoke Management System shall be equipped with 1.5 times (minimum of two) the number of belts required for operation.
3. Fan motors shall have a minimum service factor of 1.15.
4. Fans shall be supported in accordance with the building code, from non-combustible components.
5. Where fans are utilized for stair pressurization, they shall be enclosed in a 2-hour rated field assembled enclosure including (2) 12”x12” fire dampered openings for ventilation. All enclosure supports and associated power and control wiring shall be protected by a 2-hour rated system.

E. Ductwork: Ductwork shall be constructed and supported in accordance with the Mechanical Code. Ductwork shall be constructed to withstand temperatures of 250°F. Where shafts are used for pressurization or smoke evacuation, they shall be constructed to a minimum rating of +/- 25 lbs./sf or as indicated on structural documents.

F. Air Piping Used as Part of Smoke Control Systems: Hard copper tubing, Type L, wrought, copper or brass fittings installed per IBC Section 909.

2.5 ELECTRICAL POWER

A. All electrical installations shall comply with NFPA 70 National Electrical Code

B. All devices associated with the Smoke Management System requiring electrical power shall be provided with both normal and stand-by power. Transfer to stand-by power shall be automatic and occur within 10 seconds upon loss of normal power.

C. Devices associated with the Smoke Management System relying upon volatile memory shall be provided with an uninterruptible power source able to provide 15 minutes of power.

D. All power wiring shall be installed in conduit. In addition, power wiring serving smokeproof enclosure ventilation systems (such as stair or elevator pressurization systems) shall utilize a 2-hour rated cable or cable system.

E. Variable frequency drives serving smokeproof enclosure ventilation systems shall be provided with 2-hour rated enclosures with 24”x24” fire dampered opening when located indoors. All power wiring associated with such VFDs shall utilize a 2-hour rated cable or cable system per above.

2.6 CONTROLS

A. Wiring: In addition to meeting requirements of the electrical code, all wiring regardless of voltage, in conjunction with the Smoke Management System shall be installed in conduit.

B. Survivability: When wiring connecting the FSCS to any remote mounted controlling device exceeds 100 feet; the wire shall be installed within a 2-hour rated enclosure in addition to conduit. In addition, control wiring serving smokeproof enclosure ventilation systems (such as stair or elevator pressurization systems) shall utilize a 2-hour rated cable or cable system.

C. Supervision

1. Provide supervision of all components in association with the Smoke Management System. Supervision shall include positive confirmation of:

    a. Equipment operation (automatic activation, testing or manual over-ride).
    b. Presence of power down-stream of last point of disconnect for all dampers, fans and doors.
    c. Fans: Provide proof of airflow through the use of differential pressure sensors.
    d. Dampers and Makeup Air Doors: Provide proof of full open and full closed status through the use of end switches.

2. Supervision of devices shall be indicated at the FSCS.

PART 3 - EXECUTION

3.1 INDEPENDENT INSPECTOR

A. The Smoke Management System testing shall be carried out by an independent third-party Special Inspection Agency. Independent Inspector shall be a Consultant to the General Contractor.

B. The Special inspector shall be a licensed register mechanical engineer in the State of Maryland and shall be approved by the Authority Having Jurisdiction for the Smoke Management and Life Safety System.

3.2 TESTING

A. General: All components of the Smoke Management System shall be individually tested. Testing methodology shall include the following subsets:

1. Capacity test.(air volume and static pressure)
2. Functionality test.(equipment operates properly)
3. Sequence test.(equipment energizes as called for)

B. All devices shall be tested to demonstrate the correct operating sequence and output reporting under the following modes:

1. Normal power mode.
2. Stand-by power mode.
3. Manual over-ride.

C. Detection Devices:

1. All detection devices that are associated with the Smoke Management System shall be individually tested.
2. The Smoke Management System shall be tested by activating one representative detection device of each within a zone. For example, if a smoke zone is equipped with smoke detectors and water flow switches, only one smoke detector and one water flow switch need be activated within this zone.

D. Provide test report including the following data:

1. Date and time of tests.
2. Test participants, including local Code Authorities, representatives from the Design Team and the Construction Team.
3. Wind speed, wind direction and outside ambient air temperature.
4. Actual response times required for system operation.
5. Verification of correct operating sequences.
6. Fans:

    a. Examine fans for correct rotation.
    b. Record airflows.
    c. Reference Section 23 05 93 – Test Adjust and Balance for testing procedures.
    d. Provide manufacturer’s fan curve(s) and certification detailing compliance with exposure to elevated temperatures as noted above.

7. Ductwork (Including Shafts Utilized for Smoke Evacuation):

    a. All ductwork shall be leak tested to 1.5 times the maximum design pressure. Leakage shall not exceed 5% of design flow.
    b. Reference Section 23 05 93 – Test Adjust and Balance for testing procedures.

8. Inlets and outlets:

    a. Record airflow at all inlets and outlets.
    b. Reference Section 23 05 93 – Test Adjust and Balance for testing procedures.

9. Dampers: Each damper shall be tested to verify functionality.
10. Pressurization: Measure pressure differential between floors and between stairwell, vestibule and corridor(s). Measure door opening force at enclosed stairway doors.

3.3 SEQUENCE OF OPERATIONS

A. The Smoke Management System shall accomplish the following sequence reference plans of operation when activated:

END OF SECTION

SECTION 28 50 10 - AREA OF RESCUE ASSISTANCE SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

A. Furnish, install, and wire all equipment associated with the installation of a digital Area of Rescue Assistance System designed for IBC, NFPA -72 and ADA (Americans with Disabilities Act) requirements. This work shall include, but not limited to, a main control panel, remote control panels, remote call stations, power supply(s), outlet boxes, cables and wiring as shown on the drawings and as specified herein.

B. The Area of Rescue Assistance System shall include remote dialing that will automatically call an approved off-site monitoring company in the event there is no answer at the main control panel.

1.2 SUBMITTALS

A. General: Data sheets on all equipment being provided as well as recommended cable types. Internal control cabinet drawings showing internal block diagram connections shall be provided. Wiring diagrams showing typical field wiring connections as well as single line floor plan indicating equipment locations as well as cable routings and quantities.

B. Product Data: Submit product data, including manufacturer's product sheet, for specified products, including main control panel, call stations and cabling.

C. Shop Drawings: Submit shop drawings showing layout, profiles, and product components, including anchorage and accessories. Include cabling diagrams, wiring diagrams, station installation details, and equipment cabinet details.

D. Quality Assurance Submittals: Submit the following:

1. Test Reports: Certified test reports showing compliance with specified performance characteristics.
2. Manufacturer's Instructions: Manufacturer's installation instructions.
3. Manufacturer's Field Reports: Manufacturer's field reports specified herein.

E. Closeout Submittals: Submit the following:

1. Operation and Maintenance Data: Operation and maintenance data for installed products in accordance with Division 1 Closeout Submittals (Maintenance Data and Operation Data) Section.
2. Warranty: Warranty documents specified herein.

F. Project Closeout

1. A one-year maintenance contract offering continued factory authorized service of this system shall be provided as part of this contract.

2. The contractor shall furnish manufacturer's manuals of the completed system including individual specifications sheets, schematics, inter-panel and intra-panel wiring diagrams.

    a. All information necessary for the proper maintenance and operation of the system must be included.

3. As built drawings that include changes to wiring, wiring designations, junction box labeling, and other pertinent information shall be supplied upon completion of the project.
4. Provide a minimum of four (4) hours of in-service training with the system.

    a. These sessions shall be broken into segments that will facilitate the training of the system users in operating station equipment.
    b. Operating manuals and user's guides shall be provided at the time of training.

1.3 WARRANTY

A. Project Warranty: Refer to Conditions of the Contract for project warranty provisions.

B. Manufacturer's Warranty: Submit, for Owner's acceptance, manufacturer's standard warranty document executed by authorized company official. Manufacturer's warranty is in addition to, and not a limitation of, other rights Owner may have under Contract Documents.

1. Warranty Period: Minimum three (3) years commencing on the Date of Substantial Completion.
2. All materials and installation shall be guaranteed to be free of defects in material and workmanship for one year after final acceptance of installation and tests.

1.4 INSTALLATION STANDARDS

A. The system shall be installed in accordance with the IBC and ADA (Americans with Disabilities Act) requirements.

B. The completed system shall be in compliance with state and local electrical codes.

C. All wiring shall test free from grounds and shorts.

D. Install according to the manufacturer's wiring diagrams.

E. The Area of Rescue Assistance System requires installation by factory trained authorized dealers/distributors, in accordance with ANSI/NFPA 70 National Electrical Code and NFPA 72 Fire Alarm Code.

F. Properly trained personnel, familiar with Telecommunications Industry Associations 568 TIA/EIA standard, are required for proper installation. Failure to terminate the wiring correctly will cause damage to the system and void the warranty.

G. The Area of Rescue Assistance System shall be installed in a controlled, indoor dry environment, with temperatures maintained between 55°F and 95°F.

1.5 SYSTEM OPERATIONS

A. Furnish, install, and place into operation a Rescue Assistance System as indicated on the drawings and as specified herein.

B. A common control panel shall be provided at the building fire command center as authorized by local authority or the fire department where shown on the drawings to indicate light and tone signals from multiple remote call stations and allow voice communication. A secondary panel shall be installed at the main security office for response.

1. When the system is operational, a LED signals power on.
2. When the remote call station switch is activated, a one shot tone is made at the call station and a LED is lit that is steady. The call is displayed digitally on the control panel(s) with a tone along with a display of the call and its location on a 40-character LCD four line display.
3. When the alarm signal is answered by the control panel, the remote call station is signaled by the LED flashing that voice communication is initiated.
4. Voice communication with the remote call station can then be initiated from the control panel via a handset.
5. External modem connection to a public telephone system shall be provided after a programmable time delay.
6. The system shall supervise all the call stations, control panels and field switches on a continuous basis to identify line faults and defective equipment. Faults will be alerted and displayed at the control panel(s).

PART 2 - PRODUCTS

2.1 RESCUE ASSISTANCE-SYSTEM MANUFACTURER

A. Basis of Design: Rath, Inc.

B. Or approved equal. Equal to match Rath part numbers listed in this specification.

2.2 RESCUE ASSISTANCE SYSTEM AND COMPONENTS

A. Equipment

1. This system shall consist of multiple remote call stations, which will communicate with the main control panel and remote control panels as needed for a complete and operational system. The control panel(s) shall have access to a public telephone system for external alarm notification and two-way voice communication.
2. The system shall include a minimum of one control panel with the capacity to connect up to 255 call stations. Additional control panels shall be networked if additional call stations are required. In any given system there will be at least one Control Panel and between one and 255 Call Stations.
3. System wiring shall be provided per manufacturers requirements.
4. Provide signage as required by code.

B. Control Panel(s)

1. The Command Center (2500 series) shall include both the Base Station and Distribution Module. The Base Station must have a powder coated steel housing (surface or flush mount) or be desk mounted, include a black handset with coil cord and be powered from the Distribution Module.
2. The Command Center must include visual indicators to allow Rescue personnel to know which remote call station needs assistance. The Command Center must allow Rescue personnel to speak to each remote call station individual. The Command Center must include both a handset and speakerphone to communicate back to the remote call stations.
3. Distribution Module must be a surface mount enclosure, include connections for the Call Boxes and power both the Base Station and 2400 series remote call stations. The Distribution Module shall be powered from 120vac power with a battery backup that provides power for a minimum of 4 hours (Rath part # RP7700104 for 12-36 Zone or RP7700105 for 56-Up Zone).
4. The Command Center must provide an audible and visual indicator that a Remote call station has been activated.
5. The 120vac Power Supply Rath part # RP7700104 (12-36 Zone) or RP7700105 (56-Up Zone) must be capable of supplying power to the Distribution Module.
6. The power supply shall be connected to a dedicated 120V, 20A **emergency** circuit and shall include integral emergency battery backup.
7. The internal modem shall be provided to call to a designated location via a dedicated public telephone line to notify them of the alarm after a user programmed delay to allow for local response.
8. Command Center must include wording identifying the location of each Remote call station and light an LED when a particular Call Box has been activated.

C. Remote Call Station Boxes

1. The remote call station shall include a momentary switch, microphone, and loudspeaker.
2. The station shall have hands free voice communication with the control panel.
3. The station shall have silk-screened operating instructions.
4. The remote call station shall be Vandal Resistant. The standard two gang mounting plate can be flush or surface mounted and incorporates heavy-duty switches and speakers along with stainless-steel plates.
5. The station shall be an ADA compliant and vandal resistant speakerphone.
6. The station must be capable of being programmed and re-programmed on-site.
7. Provide protective covers as required on the Call Boxes per local municipal codes, use Rath 2400-XXXSSPC2.

D. Communication Sequence

1. The remote call station shall be hands-free and be a push-button-once to talk system. Once the button has been pushed, the remote call station will call the Base Station. If no answers at the Base Station, it will automatically call a pre-programmed emergency number. The remote call station must be capable of being programmed with up to 2 emergency numbers (either both off-site or Base Station and one off-site).
2. The remote call station shall have location message capability. Remote call station must have a minimum 18 second recordable message capability, programmable to play 1 or 2 times. Remote call station shall notify called party of the location of the call upon being received at the emergency dispatch center.
3. The remote call station shall be capable of allowing the called party to replay the location message, if necessary, to ensure an understanding of the caller location.

4. If system is not attended to 24 hours a day, the control panel must dial a secondary location outside the building to activate two-way off-site person to person voice communications.
5. Once a call has been made (button pushed), the call can only be terminated by the called party.
6. The station must have a red LED that will light up upon push of the button. The light shall be a solid color when the remote call station is activated, and will flash when call has been answered.

PART 3 - EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

A. Compliance: Comply with manufacturer's product data, including product technical bulletins, product catalog installation instructions, and product carton instructions for installation.

3.2 EXAMINATION

A. Site Verification of Conditions: Verify substrate conditions, which have been previously installed under other sections, are acceptable for product installation in accordance with manufacturer's instructions.

3.3 INSTALLATION

A. Command Center

1. The Command Center is to be located at a central control point on the first floor or as determined by local Authority having jurisdiction.
2. The Command Center and remote call stations (2400 series) are to be powered by the Distribution Module.
3. Distribution Module shall be powered by the Rath part # RP7700104 or RP7700105 Power Supply. It shall require a dedicated 120 VAC power and provide battery backup capable of providing a minimum of 4 hours of electrical backup in case of building power failure.
4. The Base Station shall connect to the Distribution Module with single wire pair (12-16 zone), two wire pairs (28-56 zone) and three wire pairs (76-up zone).

B. Remote Call Stations

1. Provide remote call station in each elevator lobby that is above or below the exit discharge level.
2. Provide remote call station every 5th floor in each stairway.
3. The remote call stations must allow the programming of a specific location message of the unit. This allows rescue personnel to know the location of the activated Call Box.
4. The remote call stations are to be located no higher than 48” front reach, or 54” side reach to the center of the button above ground level to ensure conformance with the ADA requirements.
5. The remote call stations are to be flush mounted.

C. Cabling Requirements

1. Wiring from the control panel to secondary control panels, field switches and the call stations shall be per manufacturer's requirements.
2. Each Remote call station shall connect to the Distribution Module with a single wire pair. Wire pairs shall be shielded if near any power runs, otherwise standard pair is acceptable. Wiring shall be Rath Custom Communication Cable (part # RP7500094). If CI 2-hour fire-rated cable is required, use Rath Communication Cable (part # RP6600300M). For a UL Listed option use part # RPP66010002.
3. Provide monitoring of the system integrity as required per NFPA 72, use Rath Supervisor Board 2500-XXSPVSR.
4. Cabling for two-way communication system shall meet the applicable requirements for pathway survivability. Cabling installation shall consist of one or more of the following:

    a. 2-hour fire-rated circuit integrity (CI) cable
    b. 2-hour fire-rated cable system

D. Rescue Assistance Signal System - Audio/Visual Installation

1. Complete system shall be installed in strict accordance with manufacturer's recommendations.
2. Wiring shall be installed in raceways throughout the building, minimum ¾" conduit.

E. Rescue Assistance System Signage

1. System shall consist of a minimum of one 120/277 VAC edge light sign (part # 7050 or 7050E), a "location" and "instruction" sign (part # 7049) to clearly indicate location of designated area.
2. A tactile sign (part # 7043/7044 or 7087) with raised letter and Braille shall be located at entrance to area.
3. Command Center must include wording identifying the location of each Remote call station and light an LED when a particular remote call station has been activated.
4. The Remote call station wording must include "Emergency Phone", International Phone Symbol and raised Braille lettering.

3.4 FIELD QUALITY REQUIREMENTS

A. Site Tests (Post Installation Testing): Checkout final connections to the system shall be made by a factory technician authorized by the manufacturer of the products installed.

1. Factory authorized technicians shall demonstrate operation of the complete system and each major component to the staff.
2. System field wiring diagrams shall be provided to the subcontractor by the manufacturer prior to installation.

B. Inspection: Perform a complete functional test of the system upon completion of the installation and instruct the staff in the operation and maintenance of the system.

3.5 CLEANING

A. Cleaning: Repair or replace damaged installed products. Remove construction debris from project site and legally dispose of debris.

END OF SECTION

This page is intentionally left blank.

SECTION 28 50 20 - EMERGENCY RESPONDER RADIO SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

A. Per IFC section 510, all new buildings shall have approved radio coverage for emergency responders within the building based upon the existing coverage levels of the public safety communications systems of the jurisdiction at the exterior of the building, with the following exceptions:

1. Where approved by the building official and the fire code official, a wired communication system may be permitted in lieu of an approved radio coverage system.
2. Where it is determined by the fire code official that the ERRS is not needed.
3. In facilities where the ERRS is required but the systems components could have a negative impact on the normal facility operations, the fire code official shall have the authority to accept an automatically activated ERRS.

B. Contractor shall provide turnkey Emergency Responder Radio System (ERRS) to provide coverage for emergency responder 2-way radio signals within the entire building, compliant with all adopted codes including, but not be limited to IBC-916, IFC-510 and NFPA-72. Note, this system may also be referenced as Emergency / First Responder DAS or Public Safety DAS.

C. Any reference to “DAS” within this specification section is for ERRS only. Cellular DAS (where applicable) is covered in another scope of work.

D. Provide RF site survey to establish benchmark signal level. Coordinate timing of site survey with Owner and General Contractor.

E. The following frequencies shall be supported and enhanced consistent with the results of the site survey and input from the local AHJ to confirm required frequencies. For pricing purposes, coverage for 700-800 MHz frequencies shall be considered the base / minimum requirement with alternate costs for adding 150 MHz and 450 MHz frequencies, where required.

1. 700 MHz
2. 800 MHz
3. VHF / 150 MHz
4. UHF / 450 MHz

F. Coverage and signal strength shall be provided per International Fire Code section 510, including requirements for radio signal strength, secondary power, installation and testing procedures.

G. The following design and installation scope is to be provided by the selected ERRS Contractor / Integrator, including but not limited to:

1. Donor antennas
2. Active DAS components (bi-directional amplifiers, head-end, remote units, etc.)
3. Passive DAS components (cabling, splitters, couplers, antennas, etc.)
4. Power supplies and 24 hours UPS battery back-up (to support active equipment)
5. Power circuits / outlets fed from base building electrical panels
6. Raceway (conduits, sleeves, j-hooks, etc.)

7. Penetrations (roof, floor, walls) and appropriate fireproofing and/or weather seals
8. Fire-wrap to satisfy 2-hour pathway survivability for riser coax (as necessary)
9. Fire alarm monitoring interface for 24/7 monitoring of system.

1.2 GENERAL REQUIREMENTS

A. The term “provide” used throughout this specification and drawings shall mean “furnish, install, test, and certify”.

B. Contractor shall fully coordinate with Authority Having Jurisdiction (AHJ) including all necessary system requirements, frequency allocations reviews and approvals with Building Department, Fire Department, Police Department, and/or other departments for determining system acceptance.

C. Contractor shall coordinate project schedule, installation schedule, phasing and any other requirements deemed necessary with Owner, CM, and all necessary Trades to ensure successful completion of work.

D. Contractor shall confirm if Union labor is required and include costs as applicable.

E. Contractor shall design, furnish, install, and configure turnkey DAS passive and active equipment, system management and monitoring software. Work shall include all necessary DAS system components and installation thereof required including raceway, penetrations (roof, floor, walls), fireproofing, weather-sealing, conduit 2-hour fire-wrapping (riser locations), cable, cable terminals, transceivers/media converters, amplifiers, equipment, power supplies, battery back-up, AC power circuits, fire alarm monitoring, drywall repair, etc. for a fully operational and functional DAS.

F. The DAS design shall be (virtually) developed, modeled and optimized using wireless computer software such as iBwave for establishing antenna locations based on electronic architectural drawings and various wireless frequency bands. Construction materials shall be inputted into the software program for structure, walls, floors, and ceilings.

G. The DAS wireless coverage and signal strength shall be field tested and verified, certified, and guaranteed upon installation, compliant with IFC-510 testing requirements.

H. The Contractor shall coordinate support systems requirements directly required by the DAS such as architectural, HVAC, electrical, and technology systems.

I. The installation of the DAS system shall comply with all local building codes, and applicable rules and regulations of the AHJ, FCC, BICSI, EIA, IEEE, NEC, TIA, UL, IFC, NFPA and other industry standards, codes, and methods.

J. All cabling shall comply with NFPA-72 pathway survivability requirements as adopted by the local AHJ. Specifically, Contractor shall confirm if AHJ considers building fully sprinkled and if there are any exceptions to the level-1 pathway survivability requirement. (Note: to comply with level-1 pathway survivability, all cabling shall be routed in metallic conduit, thus use of j-hooks or routing cable in cable tray is not allowed, unless specifically approved by the AHJ.)

K. All riser coax cables shall be routed within 2-hour rated enclosure to comply with NFPA-72 pathway survivability. Contractor shall confirm if Telecom and Electrical riser rooms are 2-hr rated or not. If riser rooms are not 2-hour rated spaces, all riser coax shall be installed in conduit that is wrapped with multiple layers of 3M (or equivalent manufacturer) fire wrap, as directed per manufacturer requirements. Additionally, splitters that tap off of riser coax shall be installed in pull-box that is also wrapped with fire wrap.

L. Plenum rated cable is required for all horizontal cable runs.

M. DAS head-end equipment and remote units shall be installed in NEMA-4X enclosures

1.3 SUBMITTALS

A. Product Data: The DAS Product Data Submittal shall be submitted for review and approval by AHJ prior to starting any work. Copies shall be provided to ME Engineers for reference only. Information shall include detailed parts list for all components and manufacturer's product data for each component to be installed.

B. Virtual Wireless Model: After project award, provide plan drawings based on architectural background or model indicating device and antenna placement based on wireless modeling computer software. Construction materials shall be inputted into the software program for structure, walls, floors, and ceilings as well as radio frequencies, zones, and capacity to help predict coverage and placement of antennas and associated coverage patterns. Information submitted shall include coverage drawing (heat map) as well as placement of antennas, equipment, cable and conduit routing, reflected ceiling plan layer, etc. Models shall be developed using iBwave or equivalent industry recognized software. Drawings shall be submitted for review and approval by AHJ prior to starting any work. Copies shall be provided to ME Engineers for reference only.

C. Field Test Reports: Indicate and interpret test results for compliance with performance requirements of installed systems as well as acceptance by AHJ.

D. Commissioning: The Contractor shall complete commissioning of the system and issue a final report. Commissioning shall be performed upon completion of system, and after its testing and retuning. Report shall be completed and finalized by the Contractor prior to system acceptance by the Owner.

E. Warranties: The Contractor shall provide a warranty on all parts, components, and labor Warranty period shall start based on acceptance by Owner upon completion of all installation, testing and optimization.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: The installation supervisor for both installation and maintenance of units required for this Project must be an experienced installer who is an authorized representative of the DAS Vendor.

1. Contractors shall have at least five (5) years of successful installation experience with projects utilizing wireless systems including DAS.
2. The company shall be a certified installer of the DAS manufacturer, and shall provide a 1-year warranty on installation/applications.

B. Electrical Components, Devices, and Accessories: These shall be listed and labeled as defined in NFPA 70, NEC, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use. All materials shall be Underwriters Laboratories (UL) Listed unless otherwise noted or required by AHJ.

1.5 CODES AND STANDARDS

A. All work including materials and installation shall conform to all applicable sections of currently adopted editions of the codes and standards listed below or the codes, standards and specifications published by the organizations listed below:

1. All applicable / adopted national, state and local codes.
2. ANSI: American National Standards Institute (ANSI).
3. ANSI/EIA/TIA standards as applicable to DAS.
4. ASTM: American Society for Testing and Materials
5. BICSI TDM Telecommunications Distribution Methods Manual (current edition).
6. BICSI Wireless Design Reference Manual (current).
7. Emergency Responder Requirements as determined by AHJ, Fire Department, Police Department, and Ambulance/EMS.
8. ICEA: Insulated Cable Engineers Association
9. IEEE: Applicable requirements and recommended installation practices of IEEE Standards 80, 81, 141 and 142 pertaining to grounding and bonding of systems, circuits and equipment.
10. IEEE-1100-1999: Recommended Practice for Powering and Grounding Sensitive Electronic Equipment.
11. International Fire Code
12. National Electrical Code
13. NESC: National Electrical Safety Code
14. NEMA: Applicable requirements of NEMA Standards/Pub No.'s OS1, OS2 and PUB 250 pertaining to raceways, outlet and device boxes, covers, and box supports.
15. NFPA-70/NEC: National Electrical Code.
16. NFPA-70B: "Recommended Practice for Electrical Equipment Maintenance" pertaining to installation of cable tray systems.
17. NFPA-72: National Fire Alarm and Signaling Code
18. UL Compliance: Applicable requirements of UL 50, UL 514-series, and UL 886 pertaining to electrical boxes and fittings.
19. UL Compliance: Applicable requirements of UL Standards No.'s 467, Electrical Grounding and Bonding Equipment", and 869 "Electrical Service Equipment", pertaining to grounding and bonding of systems, circuits and equipment. In addition, comply with UL Standard 486A, "Wire Connectors and soldering Lugs for Use with Copper Conductors." Provide grounding and bonding products which are UL-listed and labeled for their intended usage.

1.6 SEQUENCING AND HANDLING

A. All work shall be reviewed and coordinated with the Owner and/or Construction Manager prior to commencing.

B. DAS, infrastructure, and equipment are sensitive to environmental conditions including but not limited to temperature, dirt, dust, and water. The contractor shall ensure the storage and installation of all system components are sequenced and scheduled accordingly to prevent any damage, loss of performance, and warranty voiding.

C. Installation shall be coordinated with all Ceilings, Structural, Electrical, HVAC, Plumbing, Fire Protection, and other trades to eliminate disruption and/or conflict with other systems.

1.7 WARRANTY

A. Warranty periods shall be provided on the components noted below and as listed within this section. Contractor shall submit all standard manufacturer product warranty information, including warranty length for each major component, including but not limited to passive devices (antennas, splitters, couplers, etc.), cabling (coaxial, fiber, and power), active components (remote radios, head-end equipment, etc.) and power supplies (power plants, rectifiers, batteries, etc.).

B. A warranty on the Work shall be provided by the Contractor. If, within warranty time period after the date of final acceptance by Owner of the installation or within such longer period of time as may be prescribed by law or by the terms of any applicable special warranty required by the Contract Documents or provided by a manufacturer, any of the work or equipment is found to be defective or not in accordance with the Contract Documents, the Contractor shall correct it promptly including all parts and labor after receipt of notice from the Owner to do so unless the Owner has previously given the Contractor a written acceptance of such condition. This obligation shall survive termination of the contract. The Owner shall give such notice promptly after discovery of the condition. Such notice shall be provided by Owner representatives, to be identified, either verbally or in writing. Warranty period shall start based on acceptance by Owner upon completion, testing and acceptance of the installation by the Wireless Carriers.

C. The cabling Manufacturer shall provide a warranty for all cable infrastructure components. This warranty shall cover all components including cable, terminations, patch panels, and wiring panels, etc. to maintain the specified performance and physical criteria. Any such components, link, or channel shall be replaced by the Manufacturer at no cost to Owner during this period. The Contractor and Manufacturer shall submit all information and documentation on Warranty.

1.8 INSTALLATION

A. General:

1. The Contractor shall examine areas and conditions under which DAS infrastructure is to be installed. Notify Owner, Architect, and Engineer in writing of conditions detrimental to proper completion of the work. Do not proceed with work until unsatisfactory conditions have been corrected in a manner acceptable to the installer.
2. The Contractor shall be knowledgeable of work to be performed by other trades and take necessary steps to integrate and coordinate their work with other trades.
3. The Contractor shall verify space requirements and locations before starting cable installations and terminations. Inappropriate conditions shall be immediately reported to Construction Manager, Owner, Architect, and Engineer prior to initiating installation.
4. All DAS communications infrastructure shall be installed for optimal performance.
5. All DAS and communications infrastructure shall be installed to allow for easy additions, moves, and other changes in the future.
6. Final labeling scheme for all DAS and communications components shall be coordinated with the Owner and Engineer, prior to initiating work. Labeling scheme shall include but not be limited to communications rooms, cabinets, racks, cable terminal blocks and patch panels, antennas, outlets, cables, etc.
7. The Contractor is required to coordinate their efforts with the other trades and sub-contractor who may be working within the same vicinity to avoid conflict and lost time.

8. The Contractor shall supply all necessary tools, equipment, accessories, safety equipment, protective clothing, etc., as customary for the craft and necessary for the installation.
9. The contractor shall not install any component in a manner or condition that will void manufacturer and/or contractor warranty. Any such conditions that prevent an acceptable install shall be immediately reported to Construction Manager or General Contractor, Owner, Architect, and Engineer prior to initiating installation. All mis-installed components will be removed and replaced with new, appropriate components at the Contractor's expense. No additional cost will be submitted to Owner.
10. All equipment shall be installed in a neat and workmanlike manner, arranged for convenient operation, testing and future maintenance.

B. Raceway Installation:

1. Contractor shall comply with all industry codes and standards for DAS raceway installation, including but not limited to, appropriate conduit size, fill ratio, bend radii, number of bends and/or distance between pull-boxes, etc.
2. Fire seal all raceway penetration and openings to maintain fire rating after communications cables are installed.
3. Provide labels on all communications pull-boxes and junction-boxes.
4. Identify conduits at cable tray end by architectural room number.

C. Cable Installation: The following procedures shall apply to cable installation:

1. All distribution cable, backbone cable, horizontal cable, and antenna cable must be plenum rated.
2. All DAS and communications cables routed within Telecom Rooms shall be bundled and combed to provide a neat and organized appearance, per industry standards.
3. Install cables concealed in accessible ceilings. Install cables according to manufacturer's recommended installation practices using approved hangers at a maximum spacing of every 48 inches (1.2m), where deemed acceptable by AHJ.
4. Cable bends shall not be less than that recommended by the manufacturer of the cable. Do not exceed manufacturer's minimum bending radii and other cable requirements.
5. The contractor shall not install any cable in conduits that does not have the appropriate protect bushings on conduit ends.
6. Do not install bruised, kinked, scored, deformed, or abraded cable. Remove and discard cable if damaged during installation and replace it with new cable.
7. All exposed conduit routing shall be coordinated with the Architect prior to installation. Contractor shall not route any cable exposed to view. Exposed cable (when allowed by AHJ) shall only be routed in cable trays or in j-hooks above accessible ceiling.
8. Care shall be taken so as not to damage cable during the installation process and that the manufacturer's and industry standard's pull tension specification is not exceeded.

D. Antenna Installation: The following procedures shall apply to antenna installation:

1. All antenna locations shall be coordinated with ME Engineers prior to initiating any work.
2. Install antennas per manufacturer's requirements.
3. Contractor shall install antennas with all necessary supports to ensure safe installation and support to prevent falling.
4. Antennas shall be rated accordingly and as applicable for the installation type, location, condition, and application supported.

E. Equipment Installation: The following procedures shall apply to equipment installation:

1. Install surge suppressors where ac-power-operated devices are not protected against voltage transients by integral surge suppressors specified in UL1449. Install surge suppressors at the devices' power-line terminals. Comply with Division 26 Section "Transient Voltage Suppression."
2. Mount electronic equipment in the types of cabinets recommended by manufacturer. Group related items in methodical sequence.
3. Arrange equipment to facilitate access for maintenance and to preserve headroom and passage space.
4. Interface DAS equipment with all base station equipment as required during installation period of DAS.
5. Label all equipment and interfaces.

F. System Management and Monitoring Software Installation: The following procedures shall apply to system management and monitoring software installation:

1. Coordinate all work with fire alarm contractor for interface to FACP for monitoring.
2. The system management and monitoring software shall be fully set up, programmed, and configured.

G. Design Coordination: All components proposed by the Contractor shall be coordinated with the Owner and Architect.

H. Record documentation shall be submitted to the Owner by the Contractor at the completion of the DAS installation. The contractor shall submit all information necessary to operate and maintain the system including but not limited to the following:

1. As-Built Documents
2. Operations and Maintenance Manuals
3. Maintenance Schedule (with Company Contact Information)
4. Troubleshooting Guide
5. Product Data and Manufacturer Cut-Sheets
6. Warranty Information and Contact
7. Manufacturer’s Product and Installation Certificate
8. Log (troubleshooting, replacement, expansion, and replacements)
9. Labeling Scheme

PART 2 - PRODUCTS – NOT USED

PART 3 - EXECUTION – NOT USED

END OF SECTION

This page is intentionally left blank.

SECTION 28 51 00- INFORMATION MANAGEMENT AND PRESENTATION

PART 1 - GENERAL

1.1 RELATED WORK

A. Division 14 – General Elevator Requirements

B. Section 28 13 00 – Electronic Access Control System

C. Section 28 23 00 – Video Surveillance

1.2 DEFINITIONS

A. ACS – Access Control System

B. CSA – Client Software Application

C. DGM – Dynamic Graphical Maps

D. DVS – Digital Video Server

E. CDMS – Collaborative Decision Management System

F. ALPR – Automatic License Plate Recognition

G. SDK – Software Development Kit

H. SMA – Software Maintenance Agreement

I. SSM – Server Software Module

J. UI – User Interface

K. USP – Unified Security Platform

L. USW – Unified Web Client

M. VMS – Video Management System

1.3 QUALIFICATIONS

A. The system programmer shall have attended manufacturer training and obtained certification in Genetec Security Center - Omnicast™ Technical Certification.

B. Optionally, the system programmer shall have attended manufacturer training and obtained certification in Genetec Security Center - Enterprise Technical Certification.

C. The system programmer shall be a Genetec certified partner with the following level of qualification:

1. Unified Elite Reseller

D. The system programmer shall submit proof of certifications.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

A. The CDMS shall be seamlessly embedded in the Unified Security Platform (USP).

B. The CDMS shall be based on a true open architecture that shall allow the use of non-proprietary workstation and server hardware, non-proprietary network infrastructure, and non-proprietary storage.

C. The CDMS shall offer a complete and scalable operational toolset that allows real-time monitoring and situation management, as well as post-event analysis capabilities.

D. The CDMS shall be provided by the same manufacturer as the core of the USP and shall interface natively with all components of the USP including, but not limited to, VMS, ACS, communication, intrusion, plugins, and add-ons.

E. The USP and CDMS shall be forward compatible so upgrade of one does not prevent from using the other.

F. The CDMS shall be seamlessly compatible with the USP and any of its components.

G. The CDMS shall offer the following operational tools:

1. Incident management
2. Document management
3. Rules Engine
4. Automation workflow
5. Standard operating procedures
6. Incident monitoring operator interface
7. Incident reports

H. The CDMS shall provide situational intelligence to the operator with a map-centric approach and detailed overview of incident data, combining incident history, operator comments, workflow and operator action logs, standard operating procedures, relevant live and playback video, and an aggregated events sequence of the incident. Aggregation of events shall have the option to be based on the entities themselves or on designated areas on a per category basis.

I. The CDMS shall be scalable to support an average continuous flow of up to 600 events per second, with temporary bursts of 5,000 events per second. It shall be capable of dispatching a minimum of 20 incidents per second and executing associated automation workflows.

J. The CDMS architecture shall be highly reliable with zero single points of failure. The CDMS servers shall have the capacity to fail over with less than 1 minute of downtime and a guarantee of zero loss of events and incidents. No action from the user shall be required in the event of a server failure.

K. The communication between components of the CDMS shall be encrypted, robust and reliable.

L. The CDMS shall offer an SDK to customize the incident triggering, the incident closing conditions, the automation workflow activities, the incident data, and the incident details view. It shall also be possible to design custom widgets within the CDMS user interface.

M. The CDMS shall offer a standard API to trigger and dispatch incidents, get incident configurations, get incident details including content of the dynamic standard operating procedures, change incident states, change incident priorities, change incident descriptions, link incidents, change incident locations, change incident types, set incident external id, query history of an incident.

N. The standard API shall provide a notification mechanism to subscribe to incident updates

O. Any of the devices or features that are already licensed in the USP shall not require additional licenses to work within the CDMS.

P. The CDMS shall allow operator-based configuration of the CDMS users. The role-based privileges are inherited from the USP privileges.

Q. The CDMS shall log all configuration changes in an audit trail with before and after configurations.

R. The CDMS shall log all the user activities that are executed during the time that an incident is active.

S. The CDMS shall provide the capability to copy an incident configuration in part or in full to one or multiple incident types.

T. The CDMS shall provide the ability to configure incidents in a test mode that would allow user with the appropriate privilege to validate different parameters before activating the incident configuration.

2.2 CDMS GRAPHICAL USER INTERFACE

A. The CDMS shall offer a simple and user-friendly GUI within the USP GUI. The CDMS tools shall be a series of additional tasks.

B. The CDMS shall provide tasks to the USP for:

1. Incident monitoring
2. Incident detail view
3. Incident reporting
4. Incident management

C. Incident monitoring shall provide:

1. A list of current incidents. The list of current incidents shall be adaptable to the operator’s role and needs, with tools such as multi-level grouping of incidents, and advanced filtering and searching.
2. A Dynamic Graphical Map displaying incident locations and providing full situational awareness of the security in a geographical area.

3. An Incident Detail Panel with all related information for the selected incident:
    a. Overview
    b. Latest activities
    c. Related incidents
    d. Related entities
    e. Related documents
    f. Custom views (SDK)
4. Access to all controls available in the USP.

D. CDMS shall be designed for optimal use with multiscreen workstations, allowing a combination of the incident list, the dynamic graphical map, and the incident details to be displayed on each screen. The CDMS GUI shall be capable of synchronizing all screens so that the selection of an incident will automatically focus all other screens to this incident data. The screens shall have the capability of being synchronized by one or any combination of incident selection, view filter or column view settings.

E. The Dynamic Graphical Map shall provide a tooltip with incident summary when selecting an incident on the map. Multiple incidents at the same location will cluster into one object on the map. The cluster shall display the incident with the highest priority level and the number of incidents in the cluster. It shall also be possible to display a list of all the incidents within the cluster.

F. It shall be possible to configure a map to display all incidents from all maps in a single view based on their relative GPS coordinates.

G. The Incident Monitoring task can be configured to display the list of incidents, the incident map, the incident details, or any combination of these elements.

H. The incident list shall allow the operator to group the incident by:
1. Incident category
2. Incident type
3. Incident priority
4. Incident state
5. Incident location
6. Incident owner
7. Any custom incident attributes

I. It shall be possible to save the operator interface, and the configuration of the GUI shall remain the same after an operator logon or logoff.

J. The CDMS GUI shall provide advanced tools to assist operators when focusing on a mission. The filter can be applied to the current task or simultaneously on all tasks.

K. The CDMS GUI shall provide an expandable display area for editing the diagram associated with a dynamic Standard Operating Procedure.

2.3 CDMS INCIDENT MANAGEMENT

A. The CDMS shall be the interface that displays all situations as incidents.

B. The CDMS Incident management shall provide the ability to trigger incidents manually or automatically, based on a correlation of events.

C. An incident shall be the holistic description of the situation and support the following attributes:

1. Visual:

a. Color.

b. Icon. Incident management shall provide the ability to customize incident types using a set of imported icons.

2. Sound.

3. Incident category. Incident category shall allow an operator to organize incident types in a logical tree.

4. A location. The location can be an entity (camera, door, zone, area) or a geographical coordinate.

5. A priority level.

6. A description.

7. States.

8. Standard operating procedures.

9. History of activities.

10. Attach Entities. Entities related to the source of events triggering the incident shall be automatically associated to the incident.

11. Attached documents. Documents and URLs providing more information or guidance on the incident and its management.

12. A schedule during which automatic trigger of an incident by the system will be valid.

D. The CDMS shall allow the operator to configure up to 255 priority levels, configurable to respect the operation’s naming convention.

E. The CDMS shall provide a configurable state machine that will define the transition of states. For example, you can configure state E to be available only if the incident is in state C or D. Therefore, if the incident is in state A or B, state E is not available.

F. Incident states shall be configurable so that only specific users have the privilege to change the incident state to a particular state.

G. The Incident management shall provide management of incident ownership. It shall be possible to explicitly request or release the ownership of an incident. Ownership of an incident shall be provided immediately to an operator who starts working on an incident.

H. A supervisor shall be able to view all incidents that are under his supervision and see the ownership of each incident. In the same view, the supervisor shall also be provided with real-time information about who is currently monitoring an incident.

I. The CDMS shall notify the supervisor when an operator skips a step in the standard operating procedure (SOP).

J. The CDMS shall provide the capability to request the current owner's consent before taking ownership of an incident.

K. The CDMS shall provide a way to define collaborative incidents to allow multiple operators to work on the same incident.

L. It shall be possible to configure different SOP and automation workflows for different recipients of a collaborative incident.

M. It shall be possible to change the incident type, manually or automatically.

N. The CDMS shall allow the export of the incident type and category configuration with custom icons. The CDMS shall allow the exported configuration to be imported.

O. The CDMS shall allow the export of all sub-incidents attached to a collaborative incident or all incidents created from a master incident, from the automation workflow by changing the incident type manually.

P. For each incident, it shall be possible to open the incident details or configure the incident to automatically open incident details. The incident details will open on a configurable screen and provide, based on the incident type configuration, the following information:

1. A layout of all live and playback video related to the incident, including the camera associated to the source and location of the incident, as well as the local map centered on the incident location.
2. History of the incident including:
    a. All events related to the incident
    b. System automation workflow activities
    c. Operator actions for the incident
    d. Comments about the incident

Q. Operators shall be able to perform the following actions:

1. Change the incident state.
2. Forward the incident.
3. Transfer the incident.
4. Edit the incident:
    a. Change the description
    b. Change the priority level
    c. Release the ownership
5. Attach additional entities to the incident.
6. Link related incidents.

7. Attach a document as a URL link to the incident.

R. Incident Dispatch:

1. The CDMS shall provide the ability to dispatch an incident to a user or group of users. Dispatching an incident to a restricted number of users will secure the access to information.

    a. Incident dispatch shall have the capability to get dispatched to selected user group based on order of logon (round robin). If all users are logged off, incident dispatch follows the format of ordinary incident dispatch and gets dispatched to everyone in the selected user group.

2. The CDMS shall allow the distribution of specific tasks (managed as sub-incidents) that are associated to a unique incident, to different teams. Procedures can be performed in parallel.

3. Incident supervisors shall be able to see all sub-incidents associated with a main incident.

4. The CDMS shall manage the dispatch of incidents by:

    a. Incident type

    b. Schedule

    c. Location. Where it shall be possible to define the location by:

        1) Entity

        2) Area (group of entities)

5. It shall be possible to trigger a new dispatch during the course of an incident:

    a. By an operator action in the GUI. The user shall have the choice of:

        1) Transferring the incident, meaning that the incident will no longer be in the user’s incident list. The user has the option to request acknowledgement of the transfer.

        2) Forwarding the incident, meaning that the incident will continue to be in the user’s incident list and the user remains a recipient of this incident.

        3) Requesting to take ownership of the incident.

        4) Escalating an incident

6. It shall be possible to define profiles to ensure the adequate distribution of the active incidents among the operators who are currently logged on to the system and filter incidents by type and by occurrence location.

    a. The system shall have the capability to automatically assign incident management profiles to users when they log on.

    b. Profiles shall only be assigned to users that are logged on to the system.

    c. Profiles shall be assigned by the system or by users with the required privileges.

    d. It shall be possible to assign a profile to specific users or user groups.

    e. It shall be possible to specify incident types and locations associated with a profile.

f. When a profile is assigned to an operator, the system shall hide all incidents not specified by the profile from the operator's view.

g. It shall be possible to assign multiple profiles to an operator. When multiple profiles are assigned, the operator shall see the incidents specified by all assigned profiles.

h. It shall be possible to activate or deactivate an existing profile.

i. Modifications to the profile configuration shall be traceable in a report, and the report shall be exportable.

j. The load shall be balanced based on availability of the operators and their privileges

k. Incidents shall be automatically transferred to authorized recipients if no operator is online for a specific profile

S. Ability to define reminders:

a. Reminders for the operator shall be set on a schedule.

b. The reminders shall display specific text messages for the operator. Reminders shall also have to ability to be added automatically through the incident automation workflow.

c. A warning message shall be displayed when an incident is resolved with an active reminder.

2.4 CDMS INCIDENT REPORT

A. The CDMS shall offer a task to manage and generate reports. The ability to run a report is a user privilege.

B. It shall be possible to query the incident history filtering by:

1. Incident type
2. Incident state
3. Location
4. Priority
5. Trigger time range
6. Incident owner
7. Description

C. The result of a report query shall provide a list of incidents as well as a visual of these incident locations on the map. When more than one incident is reported at the location, the GUI will cluster these incidents on the map.

D. Selecting an incident from the list or on the map will display the incident details that contain the same information available in the Incident Monitoring task.

E. For closed incidents, the incident shall be in read-only mode with the exception of adding links to related incidents.

F. The Report task shall also report the user activity log of the USP for the time in which the operator was owner of the incident and was monitoring it, in order to provide a view of all actions taken towards the resolution of this incident.

G. It shall be possible to export all the data included in the details of the incident. The incident export shall at minimum include:

1. The incident overview: state, owner, description, ID, priority, location, and GPS.

2. The activity log, including comments, events, and all actions taken by the system or the operator during the resolution of this incident.

3. Related entities and documents.

4. Map snapshot. It shall be an option for the operator when exporting.

5. Camera snapshot at the time of the aggregated events. It shall be an option for the operator when exporting.

6. Video sequences of the event trigger.

H. The CDMS shall offer all reports in a visual presentation format (such as pie charts, lines, columns, and rows).

I. The CDMS shall support the following report formats:

1. HTML

2. PDF

3. XML

4. Custom format

J. Specific privileges shall be required to modify incidents from the report interface.

K. It shall be possible to generate a report based on the profiles defined for the CDMS.

L. Incident report retention period capability shall be customizable (from one to 9999 days or indefinitely).

1. The profile report shall be exportable and printable.

2. Profile reports shall allow filtering on profile identifier, initiators, recipient, and modification time.

3. Columns for the profile reports shall be configurable.

2.5 CDMS DYNAMIC DOCUMENT MANAGEMENT

A. The CDMS platform shall provide the ability to dynamically index documents to an incident in order to improve the efficiency of access to information for an operator.

B. A document shall be automatically attached to an incident if the document properties match the incident properties. The following properties shall be available:

1. Incident type

2. Schedule

3. Location. Location can be an entity or an area.

4. User or user group of the operator monitoring the incident.

C. The CDMS shall offer the ability to automatically link a document to a step in a standard operating procedure.

D. Document Management shall provide a file system to store all documents as well as the document URLs for the use of third-party file systems.

2.6 CDMS RULES ENGINE

A. The CDMS shall offer an advanced Rules Engine to correlate events and trigger incidents using Boolean rules.

B. Configuring the Rules Engine shall be graphical without need for a script.

C. The Rules Engine shall provide the ability to configure a sequence of conditions with AND and OR so that when the sequence is matched, an incident is triggered.

D. The condition of the Rules Engine shall allow the user to configure:

1. A list of events from different locations or the same location with an OR operand between them.

2. The number of occurrences of any selected events.

3. A max lapse of time during which the condition must be validated.

4. A filter for other events in the system.

E. It shall be possible to configure a complex sequence of rules by applying the occurrence, the interval, and event filtering.

F. It shall also be possible to script the rules in advance and import them into the system later.

2.7 CDMS AUTOMATION WORKFLOW ENGINE

A. The CDMS shall provide an Automation Workflow Engine to automate the response to an incident type.

B. The automation workflow shall be highly scalable and enterprise class, allowing complex business rules to be implemented.

C. The CDMS shall provide a graphical automation workflow designer. No scripting competence shall be required to implement a workflow.

D. It shall be possible to define an automation workflow for each incident type. The automation workflow shall be a series of activities that are sequentially executed.

E. It shall be possible to copy and paste a portion or the entire automation workflow within another automation workflow.

F. The automation workflow shall support the execution of parallel branches.

G. The automation workflow shall support conditional activities using IF/ELSE scenarios.

H. It shall be possible to look at door state (locked, unlocked, secured, unsecured or opened) to enable or disable additional actions.

I. The Automation Workflow Engine shall provide the following activities:

1. Acknowledge alarm
2. Add reminders
3. Aggregate events
4. Arm zones
5. Change display colors
6. Change incident descriptions
7. Change incident states
8. Change incident types
9. Change priorities
10. Close incidents
11. Delay
12. Forward incidents
13. Transfer incidents
14. Disarm zones
15. Display entities
16. Dispatch to
17. Export incidents
18. Play sounds
19. PTZ commands
20. Reset area people count
21. Run a macro
22. Send an email
23. Set threat level
24. Trigger alarms
25. Trigger incidents
26. Unlock door explicitly
27. Wait for events
28. Wait for incident states

29. Custom activities: build your own activities leveraging the SDK to interact with Security Center and/or external systems

30. Play an MP3 or WAV file to a Sipelia™ public addressing system.

31. Triggers output

32. Enable/Disable state transition

33. Wait for incident priority

J. The Automation Workflow Engine shall provide a framework to create custom activities that allow integration into a global business process.

K. The Automation Workflow shall provide a way to access contextual information for Mail and Macro activities.

2.8 CDMS STANDARD OPERATING PROCEDURE

A. The CDMS shall provide guidance for operators in the form of a standard operating procedure (SOP) for the response to an incident type.

B. The SOP shall be interactive and offer an operator-acknowledgement-audit for each SOP step.

C. The SOP shall be dynamic and provide the ability to adapt the next steps in a procedure based on the responses to previous steps in the procedure.

D. The configuration of the dynamic sequence for the SOP shall be visually represented by a flowchart.

E. The CDMS GUI shall provide the ability to skip a step of the SOP and request a justification for skipping the step.

F. It shall be possible to configure an SOP to be either sequential, requiring the validation of each step in order to access the next one, or to be left at the discretion of the operator to execute the steps as a check list in a free order.

G. The SOP shall be configurable so that the validation of all steps in the SOP is required in order to close the incident.

H. Each step shall be optionally associated to a document in the form of a URL, or a document in a supported format (such as Word, PDF, or HTML).

I. The CDMS shall track the elapsed time for each step of the SOP, as well as the total elapsed time from the initial response to resolution.

J. The CDMS shall provide the capability to import and export the SOP individually as CSV files.

K. The CDMS shall provide the ability to configure standard options when defining dynamic steps of the SOP.

L. The CDMS shall provide the ability to configure Dynamic SOP (DSOP) with a decision tree view.

M. The CDMS shall provide the ability to execute specific actions based on DSOP answers. Answers shall be provided via predefined or custom selections. Selections can be made using a mouse or keyboard shortcuts.

N. The CDMS shall provide a GUI to configure the DSOP and connect the different steps based on the operator answer. The CDMS shall provide the ability to call a Sipelia™ device when using Sipelia™ integration from the dynamic SOP step.

O. A maximum delay shall be allowed for a user to initiate the procedure. Automated actions associated with this time to response threshold shall be configurable.

P. A maximum delay shall be allowed for a user to complete the procedure. Automated actions associated with this time to resolution threshold shall be configurable.

Q. A minimum time shall be allocated for a user to complete the procedure. Closing the incident before passing this time to resolution threshold shall trigger automated actions.

R. A visual indicator shall be displayed when maximum time to response or the maximum time to resolution for the incident is exceeded.

2.9 ELECTRONIC ACCESS CONTROL SYSTEM

A. The Information Management & Presentation shall be unified seamlessly with the Access Control System specified in section 28 13 00 within the USP. All the access control features available in the USP shall be available to the Information Management & Presentation software.

B. The Information Management & Presentation shall be unified seamlessly with the Access Control System plugins of the USP. All the access control features available in the USP shall be available to the Information Management & Presentation software.

2.10 VIDEO MANAGEMENT SYSTEM

A. The Information Management & Presentation shall be unified seamlessly with the Video Management System specified in section 28 23 00 within the USP. All video management features available in the USP shall be available to the Information Management & Presentation software.

B. The Information Management & Presentation shall be unified seamlessly with the Video Management System plugins of the USP. All the video management features available in the USP shall be available to the Information Management & Presentation software.

2.11 SERVER ADMINISTRATOR USER INTERFACE REQUIREMENTS

A. The Server Administrator shall be used to configure the SSM and the Directory Role (main configuration) and its database(s), to apply the license, and more.

B. The Server Administrator shall be a web-based application. Through the Server Administrator, it shall be possible to access the SSM across the network or locally on the server.

C. Access to the Server Administrator shall be protected via login name, password, and encrypted communications.

D. The Server Administrator shall allow the administrator (user) to perform the following functions:

1. Manage the system license.

2. Configure the database(s) and database server for the Directory Role.

3. Activate/Deactivate the Directory Role.

4. Manually back up the Directory Role database(s) and/or restore the server database(s), as well as configure scheduled backups of the databases.
5. Define the client-to-server communications security settings.
6. Configure the network communications hardware, including connection addresses and ports.

2.12 SMARTPHONE AND TABLET APP GENERAL REQUIREMENTS

A. The USP shall support mobile apps for various off-the-shelf devices. The mobile apps shall communicate with the USP over any Wi-Fi or mobile network connection.

B. Mobile apps shall communicate with the USP via a Mobile Server Role (MSR). All communication between the mobile apps and the MSR shall be based on standard TCP/IP protocol and shall use TLS encryption with digital certificates to secure the communication channel.

C. Supported device manufacturers shall include (refer to Mobile App specifications for latest compatibility list):

1. Apple devices running iOS 11 or later
2. Android devices 6.0 or later

D. It shall be possible to download the mobile apps from the Central application store (Apple iTunes App Store, Google Play).

E. It shall be possible to push configuration to the mobile devices through a Mobile Device Management solution such as VMWare Workspace One or Microsoft Intune.

F. Functionalities

1. Core

a. Ability to logon/logoff to the USP using an authorized user profile of the system.
b. Ability to support passive authentication from a single sign-on provider (Open ID Connect or SAML2 identity provider)
c. Ability to use biometric features (thumbprint, face ID, etc.) to perform connection to the system.
d. Ability to change the picture or the password of the user of the mobile app.
e. Ability to view the current Threat Level of the system.
f. Ability to change the current Threat Level of the system.
g. Ability to execute hot actions configured in the user profile.
h. Ability to view entities from the USP:

1) Cameras
2) Doors
3) ALPR cameras
4) Web Tile Plugins

5) Layouts

6) Camera Sequences

7) Macros

i. Ability to navigate the system hierarchical view of the entities and search entities in the system.

2. Video

a. Ability to view live and recorded video from the cameras of the USP. A maximum of four cameras shall be displayed.

b. Ability to view video in native format (H.264).

c. Ability to display live and recorded video side-by-side for a specific camera.

d. Ability to perform digital zoom on cameras.

e. Ability to perform actions on cameras such as add a bookmark, control a PTZ, control the iris/focus function, save a snapshot, start/stop recording.

f. Ability to view camera layouts.

g. Ability to view camera sequences.

h. Ability to run a camera events report.

i. Ability to change the video quality on the cameras displayed on the mobile app.

j. Ability to use the camera of the smartphone and stream a live video feed to a video recorder in the system.

3. Access Control

a. Ability to view the door state and the door lock state.

b. Ability to perform actions on a door, such as unlock the door, set the door in maintenance mode, override the door unlocking schedule.

4. Automatic License Plate Recognition

a. Ability to view live events raised by an ALPR camera.

b. Ability to view the read image, context image, and all metadata captured by the ALPR camera

c. Ability to run an ALPR event report.

d. Ability to add a license plate to a hotlist on the system.

5. Alarm Management

a. Ability to receive push notifications to notify mobile operators that an alarm was received.

b. Ability to view all active alarms assigned to the mobile operator.

c. Ability to perform action on an alarm such as acknowledge, forward, or alternate-acknowledge an active alarm.

d. Ability to view entities attached to the alarm.

6. Map

a. Ability to display a geographic map with USP entities geo-located on the map.

b. Ability to view any entity configured on the map.

c. Ability to search for entities or locations on the map.

G. It shall be possible to send a message from the client user interface to a mobile operator.

H. It shall be possible to send a live or playback video sequence from the client UI to a mobile operator.

I. It shall be possible to view mobile operators who enabled location tracking on a map in the system. The location of the mobile operator should update in real time

2.13 HEALTH MONITOR

A. The USP shall monitor the health of the system, log health-related events, and calculate statistics.

B. USP services, roles, agents, units, and client apps will trigger health events.

C. The USP shall populate the Windows Event Log with health events related to USP roles, services, and client apps.

D. A dedicated role, the Health Monitoring Role, shall perform the following actions:

1. Monitor the health of the entire system and log events.

2. Calculate statistics within a specified time frame (hours, days, months).

3. Calculate availability for clients, servers, and video/access/ALPR units.

E. A Health Monitoring task and Health History reporting task shall be available for live and historical reporting.

F. A Health Monitoring dashboard task shall be available in the client application user interface to provide a live display, such as pie charts and event lists, for quick visual assessment on the general health of the system.

G. A web-based, centralized health dashboard shall be available to remotely view unit and role health events of the USP.

H. Detailed system care statistics will be available through a web-based dashboard providing health metrics of USP entities and roles, including Uptime and mean-time-between-failures.

I. All events raised in the system can be used for automating the UPS event/action management.

J. Health events shall be accessible via the SDK (can be used to create SNMP traps).

2.14 USP GENERAL REQUIREMENTS

A. The Unified Security Platform (USP) shall be an enterprise class IP-enabled security and safety software solution.

B. The USP shall support the seamless unification of IP access control system (ACS), IP video management system (VMS), and IP automatic license plate recognition system (ALPR) under a single platform. The USP user interface (UI) applications shall present a unified security interface for the management, configuration, monitoring, and reporting of embedded ACS, VMS, and ALPR systems and associated edge devices.

C. Functionalities available with the USP shall include:

1. Configuration of embedded systems, such as ACS, ALPR, and VMS systems.
2. Live event monitoring.
3. Live video monitoring and playback of archived video.
4. Alarm management.
5. Reporting, including creating custom report templates and incident reports.
6. The Federation feature for global monitoring, reporting, and alarm management of multiple remote and independent ACS, VMS, and/or ALPR systems spread across multiple facilities and geographic areas.
7. Global cardholder management across multiple facilities and geographic areas each with their own independent ACS system.
8. Microsoft Active Directory integration for synchronizing USP user accounts and ACS cardholder accounts.
9. Intrusion device and panel integration (live monitoring, reporting, and arming/disarming).
10. SIP Intercom device integration for bi-directional communication.
11. Integration with third party systems and databases via plug-ins (access control, video analytics, point of sale, and more).
12. Dynamic graphical map viewing.
13. Asset management system integration.

D. The USP shall be deployed in one or more of the following types of installations:

1. Unified access, ALPR, video platform, and any combination thereof.
2. Standalone access control, ALPR, or video platform.
3. Unified access and video platform that federates multiple remote ACS, VMS, and ALPR.
4. Standalone video platform that federates multiple independent remote VMS.
5. Standalone access control that federates multiple independent remote ACS.
6. Standalone access control that federates multiple independent remote ALPR.

E. Licensing:

1. A single central license shall be applied centrally on the configuration server.
2. There shall be no requirement to apply a license at every server computer or client workstation.

3. Based on selected options, one or more embedded systems shall be enabled or disabled.

F. Hardware and Software Requirements:

1. The USP and embedded systems (video, license plate recognition, and access control) shall be designed to run on a standard PC-based platform loaded with a Windows operating system. The preferred operating system shall be coordinated with the Owner following the manufacturer supported operating systems.

2. The core client/server software shall be built in its entirety using the Microsoft .NET software framework and the C# (C-Sharp) programming language.

3. The USP database server(s) shall be built on Microsoft's SQL Server. The preferred SQL version shall be coordinated with the Owner and compatible with the USP.

4. The USP shall be compatible with virtual environments, including VMware and Microsoft Hyper-V.

5. The USP shall use the latest user interface (UI) development and programming technologies such as Microsoft WPF (Windows Presentation Foundation), the XAML markup language, and .NET software framework.

2.15 USP ARCHITECTURE

A. The USP shall be based on a client/server model. The USP shall consist of a standard Server Software Module (SSM) and Client Software Applications (CSA).

B. The USP shall be an IP enabled solution. All communication between the SSM and CSA shall be based on standard TCP/IP protocol and shall use TLS encryption with digital certificates to secure the communication channel.

C. The SSM shall be a Windows service that can be configured to start when the operating system is booted and run in the background. The SSM shall automatically launch at computer startup, regardless of whether or not a user is logged on the machine.

D. Users shall be able to deploy the SSM on a single server or across several servers for a distributed architecture. The USP shall not be restricted in the number of SSM deployed.

E. The USP shall support the concept of The Federation feature whereby multiple independent ACS, VMS, ALPR installations can be merged into a single large virtual system for centralized monitoring, reporting, and alarm management.

F. The USP shall protect against potential database server failure and continue to run through standard off-the-shelf solutions.

G. The USP shall support up to one thousand instances of CSA connected at the same time. However, an unrestricted number of CSA can be installed at any time.

H. The USP shall support an unrestricted number of logs and historical transactions (events and alarms) with the maximum allowed being limited by the amount of hard disk space available.

I. The USP shall support uninterrupted video streaming. The CSA shall keep existing video connections active in the event that an SSM (except Archiver) becomes unavailable.

J. Roles-Based Architecture:

1. The USP shall consist of a role-based architecture, with each SSM hosting one or more roles.
2. Each role shall execute a specific set of tasks related to either core system, automatic license plate recognition (ALPR), video (VMS), or access control (ACS) functionalities, among many others. Installation shall be streamlined through the ability of the USP to allow administrators to:
    a. Deploy one or several SSM across the network prior to activating roles.
    b. Activate and deactivate roles as needed on each and every SSM.
    c. Centralize role configuration and management.
    d. Support remote configuration.
    e. Move roles over from one SSM to another.
3. Each role, where needed, shall have its own database to store events and role-specific configuration information.
4. Roles without databases, such as The Federation feature, Active Directory, and Global Cardholder Management, shall support near real-time standby without any third party failover software being required.
5. Directory Role:
    a. The Directory Role shall manage the central database that contains all the system information and component configuration of the USP.
    b. The Directory Role shall authenticate users and give access to the USP based on predefined user access rights or privileges, and security partition settings.
    c. The Directory Role shall support the configuration/management of the following components common to the ACS, ALPR, and VMS sub-systems:
        1) Security Partitions, users and user groups
        2) Areas
        3) Zones, input/output (IO) linking rules, and custom output behavior
        4) Alarms. Schedules, and scheduled tasks
        5) Custom events
        6) Macros or custom scripts
    d. The Directory Role shall support the configuration/management of the following components specific to VMS:
        1) Video servers and their peripherals (for example audio, IOs, and serial ports)
        2) PTZ
        3) Camera sequences
        4) Recording and archiving schedules

e. The Directory Role shall support the configuration/management of the following components specific to ACS:

1) Door controllers, and input and output (IO) modules

2) Doors, Elevators, and Access rules

3) Cardholders and cardholder groups, credentials, and badge templates

f. The Directory Role shall support the configuration/management of the following components specific to ALPR:

1) ALPR units and cameras

2) Hotlists, permit lists, and overtime rules

6. The Video Archiver Role shall be responsible for managing cameras and encoders under its control and archiving.

7. The Media Router Role shall be responsible for routing video and audio streams across local and wide area networks from the source (for example DVS) to the destination (for example CSA).

8. The Access Manager Role shall be responsible for synchronizing access control hardware units under its control, such as door controllers and I/O modules. This role shall also be responsible for validating and logging all access activities and events when the door controllers and I/O modules are online.

9. The Automatic License Plate Recognition (ALPR) Role shall be responsible for synchronizing fixed ALPR units (cameras) and mobile ALPR applications under its control. The ALPR Role shall also be responsible for logging all ALPR activities and events.

10. The Zone Manager Role shall be responsible for managing all software zones (collection of inputs) and logging associated zone events. Zones shall consist of inputs from both access control and video devices.

11. The Health Monitoring Role shall be responsible for monitoring and logging health events and warnings from the various client applications, roles, and services that are part of the USP. This role shall also be responsible for logging events within the Windows Event Log and for generating reports on health statistics and health history.

12. Optional Roles

a. The Active Directory Role shall be responsible for synchronizing user accounts and cardholder accounts with a Microsoft Active Directory server.

b. The Intrusion Manager Role shall be responsible for managing third party intrusion devices such as alarm panels and perimeter detection devices. This role shall also be responsible for logging all intrusion events in a database.

c. The Asset Manager Role shall be responsible for integrating and synchronizing with third party asset management systems and logging asset related events. This role shall also be responsible for supporting the execution of asset-related reports such as inventory reports and asset activity reports.

d. The Plug-in Manager Role shall be responsible for the communication between the USP and third party systems such as video analytics, ALPR, access control, video, and building management systems.

e. The Web SDK Role shall be responsible for connecting the USP to any application or interface developed with the Web Service SDK. Applications developed with the Web Service SDK shall be platform independent and rely on the REST protocol for communications.

f. The Communication Management Role shall be responsible for registering the SIP communication endpoints and for managing the call routing.

g. The Video Redirector Role shall be responsible for connecting any video stream to a third party system using standard RTSP protocol. This role shall provide access to live video.

K. Server Monitoring Service (Watchdog):

1. The USP shall include a Server Monitoring Service that continuously monitors the state of the Server Software Module (SSM) service.

2. The Server Monitoring Service shall be a Windows service that automatically launches at system startup, regardless of whether or not a user is logged into his account.

3. The Server Monitoring Service shall be installed on all PCs/servers running an SSM. In the event of a malfunction or failure, the Server Monitoring Service shall restart the failed service. As a last resort, the Server Monitoring Service shall reboot the PC/server should it be unable to restart the service.

2.16 USP ACCESS CONTROL, VIDEO, AND ALPR UNIFICATION

A. The Monitoring UI shall present a true Unified Security Interface for live monitoring and reporting of the ACS, VMS, and ALPR. Advanced live video viewing and playback of archived video shall be available through the Monitoring UI.

B. The Configuration UI shall present a true Unified Security Interface for the configuration and management of the ACS, VMS, and ALPR.

C. The user shall be able to associate one or more video cameras to the following entity types: areas, doors, elevators, zones, alarms, intrusion panels, ALPR cameras, and more.

D. It shall be possible to view video associated to access control events when viewing a report.

E. It shall be possible to view video associated to intrusion panel events when viewing a report.

F. It shall be possible to view video associated to ALPR events when viewing a report.

G. The USP shall support the following Alarm Management functionality:

1. Create and modify user-defined alarms. An unrestricted number of user-defined alarms shall be supported.

2. Assign a time schedule or a coverage period to an alarm. An alarm shall be triggered only if it is a valid alarm for the current time period.

3. Set the priority level of an alarm and its reactivation threshold.

4. Define whether to display live or recorded video, still frames or a mix once the alarm is triggered.

5. Provide the ability to display live and recorded video within the same video tile using picture-in-picture (PiP) mode.

6. Provide the ability to group alarms by source and by type.
7. Define the time period after which the alarm is automatically acknowledged.
8. Define the recipients of an alarm. Alarm notifications shall be routed to one or more recipients. Recipients shall be assigned a priority level that prioritizes the order of reception of an alarm.
9. Define the alarm broadcast mode. Alarm notifications shall be sent using either a sequential or an all-at-once broadcast mode.
10. Define whether to display the source of the alarm, one or more entities, or an HTML page.
11. Specify whether an incident report is mandatory during acknowledgment.

H. The workflows to create, modify, add instructions and procedures, and acknowledge an alarm shall be consistent for access control, ALPR, and video alarms.

I. Alarms shall be federated, allowing global alarm management across multiple independent USP, ACS, VMS, and ALPR systems.

J. The USP shall also support alarm notification to an email address or any device using the SMTP protocol.

K. The ability to create alarm-related instructions shall be supported through the display of one or more HTML pages following an alarm event. The HTML pages shall be user-defined and can be interlinked.

L. Alarm unpacking and packing shall be supported where all the entities associated to an alarm can be display in the Monitoring UI with the single click of a button.

M. The user shall have the ability to acknowledge alarms, create an incident upon alarm acknowledgement, and put an alarm to snooze.

N. The user shall be able to spontaneously trigger alarms based on something he or she sees in the system.

O. An alarm shall be configured in such a way that it remains visible until the source condition has been acknowledged.

P. The user shall be able to investigate an alarm without acknowledging it.

2.17 USP THREAT LEVELS

A. The USP shall support Threat Levels to dynamically change the system behavior to respond to critical events.

B. Threat Levels shall be activated and deactivated by the CSA operator with the right privilege.

C. Threat Levels shall be set on an area or on the entire system.

D. Threat Levels shall affect the system behavior by executing any action available in the USP such as: trigger output, start recording, block camera, override recording quality, arm zone, set a door in maintenance mode, and more.

E. The following specific actions shall be available with Threat Level:

1. Set minimum security clearance to restrict or permit access to cardholders on specific areas on top of the restrictions imposed by the access rules.
2. Set minimum user level to automatically log out user from the USP.
3. Set reader mode to change how the doors are accessed (for example card and PIN, or card or PIN).

F. A visible notification shall be displayed in all operator CSA when a Threat Level is activated.

2.18 USP REMOTE TASK

A. The USP shall provide, through a Remote Task, capabilities to remotely monitor and control the content of other workstations running the CSA (Monitoring UI) that are part of the same system.

B. The USP shall support video wall applications by connecting and controlling multiple workstations and monitors simultaneously.

C. The Remote Task shall be a graphical interface showing a replication of the remote workstation running the CSA (Monitoring UI).

D. The Remote Task shall allow the connection to other workstations using a low bandwidth mode to receive only snapshots of video viewed remotely.

E. The Remote Task shall allow the connection to other workstations using a spy mode to remain invisible to the remotely connected workstation. The spy mode option should be available to users with permission to access the feature.

F. The functionality provided by the remote monitoring and control capability shall include:

1. Remote monitoring and control of the monitoring and alarm monitoring tasks.
2. Ability to remotely switch cameras, doors and zones into display tiles.
3. Ability to remotely control live and playback video.
4. Ability to remotely change the tile pattern.
5. Ability to remotely create and delete tasks.
6. Ability to remotely start/stop task cycling.
7. Ability to remotely go into full screen mode.
8. Ability to remotely save and reload the workspace.

2.19 USP ADVANCED TASK MANAGEMENT

A. USP shall support an infrastructure for managing Monitoring UI tasks used for live monitoring, day to day activities, and reporting.

B. Administrators shall be able to assign tasks and lock the operator`s workspace. The user management of their workspace shall be limited by their assigned privileges.

C. Operators shall be able save their tasks as either Public Tasks or Private Tasks and in a specific partition. Public tasks shall be available to all users. Private tasks shall only be available to the owner of the task.

D. Operators shall be able to share their tasks by sending them to one or more online users. Recipients shall have the option to accept the sent task.

E. Operators shall be able to duplicate a task.

2.20 USP REPORTING

A. The USP shall support report generation (database reporting) for access control, ALPR, video, and intrusion.

B. Each and every report in the system shall be a USP task, each associated with its own privilege. A user shall have access to a specific report task if they have the appropriate privilege.

C. The workflows to create, modify, and run a report shall be consistent for access control, ALPR, and video reports.

D. Reports shall be federated, allowing global consolidated reporting across multiple independent USP, ACS, VMS, and ALPR systems.

E. Access control and ALPR reports shall support cardholder pictures and license plate pictures, respectively.

F. The USP shall support the following types of reports:

1. Alarm reports
2. Video-specific reports (archive, bookmark, motion, and more)
3. Configuration reports (cardholders, credentials, units, access rules, readers/inputs/outputs, and more)
4. Activity reports (cardholder, cardholder group, visitor, credential, door, unit, area, zone, elevator, and more)
5. ALPR-specific reports (mobile ALPR playback, hits, plate reads, reads/hits per day, reads/hits per ALPR zone, and more)
6. Health activity and health statistics reports
7. Other types of reports, including visitor reports, audit trail reports, incident reports, and time and attendance reports

G. Generic Reports, Custom Reports, and Report Templates

1. The user shall the option of generating generic reports from an existing list, generating reports from a list of user-defined templates, or creating a new report or report template.
2. The user shall be able to customize the predefined reports and save them as new report templates. There shall be no need for an external reporting tool to create custom reports and report templates. Customization options shall include setting filters, report lengths, and timeout period. The user shall also be able to set which columns shall be visible in a report. The sorting of reported data shall be available by clicking on the appropriate column and selecting a sort order (ascending or descending).
3. All report templates shall be created within the Monitoring UI.
4. These templates can be used to generate reports on a schedule in PDF or Excel formats.

5. An unrestricted number of custom reports and templates shall be supported.

H. A reporting task layout shall consist of panes with settings (report length, filters, go and reset commands, etc.), the actual report data in column format, and a pane with display tiles. The user shall be able to drag and drop individual records in a report onto one or more display tiles to view a cardholder's picture ID, playback a video sequence, or an ALPR event.

I. The USP shall support comprehensive data filtering for most reports based on entity type, event type, event timestamp, custom fields, and more.

J. The reporting task shall have the ability to display results through graphics such as line charts, bar charts, stacked bar charts, doughnut charts, and pie charts.

K. The user shall be able to click on an entity within an existing report to generate additional reports from the Monitoring UI.

L. The USP shall support the following actions on a report: print report, export report to a PDF/Microsoft Excel/CSV file, export the graphics chart in JPG/PNG, and automatically email a report based on a schedule and a list of one or more recipients.

2.21 USP DASHBOARDS

A. The USP shall support the ability to create dashboards.

B. Operators shall be allowed to view dashboards if they are granted the appropriate privilege. Modifications to dashboards should also be allowed to users granted the appropriate privilege.

C. Dashboards in the system shall be a USP task. A user shall have access to a specific dashboard task if they have the appropriate privilege.

D. Dashboards shall be saved either in a private folder or a public folder.

E. A dashboard shall consist of a canvas with various widgets displayed on the canvas. All widgets should offer the ability to specify location and size to the widget, a title to the widget, a background color to the widget, and the ability to refresh periodically the content of the widget.

F. Dashboard widget types shall be:

1. Image: provides the ability to display an image (JPG, PNG, GIF, BMP) on a dashboard.

2. Text: provides the ability to display a text on a dashboard. The text style shall be configurable, so font, size, color, and alignment can be specified by the user.

3. Tile: provides the ability to display any entity of the USP inside of a tile.

4. Web page: provides the ability to display a URL on a dashboard.

5. Entity Count: provides the ability to display the total number of a specific entity type in the USP.

6. Reports: provides the ability to display the results of any saved reports in the system. The results shall be displayed either by showing the total number of results in the report, a set of top results from the report, or a visual graph from the data returned by the report.

G. It shall be possible to extend the widgets of a dashboard using the SDK. This will provide the ability to develop custom widgets to the system.

H. The USP shall support the following actions on a dashboard: print dashboard; export dashboard to PNG file; automatically email a report based on a schedule and a list of one or more recipients.

2.22 USP FEDERATION FEATURE: MONITORING OF REMOTE SYSTEMS

A. The USP shall support the concept of a Federation feature for access control, video, and ALPR.

B. The Federation feature shall allow multiple independent USP systems (Federated systems) to be unified into a larger virtual system (the Federation feature). This shall facilitate the global monitoring of multiple independent USP systems.

C. The Federation feature shall support the unification of multiple independent video surveillance systems or VMS.

D. Entities that shall be federated and monitored centrally from the Federation feature shall include alarms, areas, cameras, cardholders and cardholder groups, credentials, doors, elevators, ALPR events, and zones (monitored inputs).

E. The Federation feature shall support a cloud-based deployment, whereby the service and infrastructure will be updated automatically and provisioned by the service provider, without need for on-site hardware.

F. The Federation feature shall support Global Alarm Management from the Monitoring UI for access control, video, and ALPR.

G. The Federation feature shall support Global Report Generation from the Monitoring UI for access control, video, and ALPR.

H. The Federation feature shall support dozens of operator actions on remote (federated) entities from the Monitoring UI (for example, generating a global report taking into account events from multiple independent sites or acknowledging remote alarms).

2.23 USP ZONE MANAGEMENT

A. The USP shall support the configuration and management of zones for input point monitoring via the Zone Manager Role. A user shall be able to add, delete, or modify a zone if they have the appropriate privileges.

B. A zone shall monitor the status of one or more inputs points. Zone monitoring or input point monitoring shall be possible through the use of a controller and one or more input modules. Inputs from video cameras or video encoders shall also be accessible via a zone.

C. Depending on the hardware installed, supervised inputs shall be supported. Depending on the input module used, both 3-state and 4-state supervision shall be available.

D. A schedule shall be defined for a zone, indicating when the zone will be monitored.

E. Custom Events shall provide full flexibility in creating custom events tailored to a zone. Users shall be able to associate custom events to state changes in monitored inputs.

F. The ACS shall support one or more cameras per zone. Video shall then be associated to zone state changes.

G. Input/Output (IO) Linking:

1. Zone management shall support Input/Output (IO) Linking. I/O Linking shall allow one or more inputs to trigger one or more outputs.
2. IO Linking shall be available in offline mode when communication between the server and hardware is not available.
3. Custom Output Behaviors shall provide full flexibility in creating a variety of complex output signal patterns: simple pulses, periodic pulses, variable duty-cycle pulses, and state changes.
4. Through the “trigger an output” action, the ACS shall support the triggering of outputs with custom output behaviors.

2.24 USP USER AND USER GROUP SECURITY, PARTITIONS, AND PRIVILEGES MANAGEMENT

A. The USP shall support the configuration and management of users and user groups. A user shall be able to add, delete, or modify a user or user group if they have the appropriate privileges.

B. The USP shall support user authentication with claims-based authentication using external providers. External providers shall include:

1. ADFS (Active Directory Federation Services)
2. Azure Active Directory (through OpenID Connect)
3. Ping Identity (through OpenID Connect)
4. KeyCloak (through OpenID Connect)
5. Other Open ID Connect / SAML2 authentication agents

C. Common access rights and privileges shared by multiple users shall be defined as User Groups. Individual group members shall inherit the rights and privileges from their parent user groups. User group nesting shall be allowed.

D. User privileges shall be extensive in the USP. All configurable entities for the USP, including access control, video, and ALPR shall have associated privileges.

E. Specific entities, such as cardholders, cardholder groups, and credentials shall include a more granular set of privileges, such as the right to access custom fields and change the activation or profile status of an entity.

F. Partitions:

1. The USP shall limit what users can view in the configuration database via security partitions (database segments). The administrator, who has all rights and privileges, shall be allowed to segment a system into multiple security partitions.
2. All entities that are part of the USP can be assigned to one or more partitions.
3. A user who is given access to a specific partition shall only be able to view entities (components) within the partition to which they have been assigned. Access is given by assigning the user as an accepted user to view the entities that are members of a particular partition.
4. A user or user group can be assigned administrator rights over the partition.

G. It shall be possible to specify user and user group privileges on a per partition basis.

H. Advanced logon options shall be available such as dual logon and more.

I. It shall be possible to specify an inactive period for the Monitoring UI after which time the application shall automatically lock, while still preserving access to currently displayed camera feeds.

J. It shall be possible to review user permissions and determine:

1. For any entity in the system, which user group or user can view or modify it.

2. For any user group or user in the system, what are its privileges.

3. For any privilege in the system, which user group or user is allowed to perform the underlying action.

2.25 USP EVENT/ACTION MANAGEMENT

A. The USP shall support the configuration and management of events for video and ALPR. A user shall be able to add, delete, or modify an action tied to an event if he has the appropriate privileges.

B. The USP shall receive all incoming events from one or more ACS, VMS, and ALPR. The USP shall take the appropriate actions based on user-define event/action relationships.

C. The USP shall receive and log the following events:

1. System-wide events

2. Application events (clients and servers)

3. Area, camera, door, elevator, and ALPR events (reads and hits)

4. Unit events

5. Zone events

6. Alarm events

7. ALPR events

8. Health Monitoring events

D. The USP shall allow the creation of custom events.

E. The USP shall have the capability to execute an action in response to an access control, video, and ALPR event. The USP shall support the following list of actions, without being limited to:

1. Add bookmark

2. Block and unblock video

3. Display a camera on an analog monitor

4. Display an entity in the CSA

5. Email a report

6. Email a snapshot
7. Export report
8. Go home
9. Go to preset
10. Override recording quality
11. Play a sound
12. Reboot unit
13. Run a macro
14. Run a pattern
15. Send a message
16. Send an email
17. Set threat level
18. Start/Stop applying video protection
19. Start/Stop recording
20. Start/Stop transfer
21. Trigger alarm
22. Trigger output

F. The USP shall allow a schedule to be associated with an action. The action shall be executed only if it is an appropriate action for the current time period.

2.26 USP SCHEDULES AND SCHEDULED TASKS

A. Schedules

1. The USP shall support the configuration and management of complex schedules. A user shall be able to add, delete, or modify a schedule if they have the appropriate privileges.
2. The USP shall provide full flexibility and granularity in creating a schedule. The user shall be able to define a schedule in 1-minute or 15-minute increments.
3. Daily, weekly, ordinal, and specific schedules shall be supported.

B. Scheduled Tasks

1. The USP shall support scheduled tasks for video, and ALPR.
2. Scheduled tasks shall be executed on a user-defined schedule at a specific day and time. Recurring or periodic scheduled tasks shall also be supported.
3. Scheduled tasks shall support all standard actions available within the USP, such as sending an email or emailing a report.

2.27 USP MACROS AND CUSTOM SCRIPTS

A. The USP shall enable users to automate and extend the functionalities of the system through the use of macros or custom scripts for access control, video, and ALPR.

B. Custom macros shall be created with the USP Software Development Kit (SDK).

C. A macro shall be executed either automatically or manually.

D. In the Monitoring UI, a macro shall be launched through hot actions.

2.28 USP DYNAMIC GRAPHICAL MAPS (DGM)

A. The USP shall support mapping functionality for access control, video surveillance, intrusion detection, ALPR, and external applications.

B. The USP shall provide a map centric interface with the ability to command and control all the USP capabilities from a full screen map interface.

C. It shall be possible to span the map over all screens of the USP client station. In the scenario where the map is spanned over all the screens of the USP client station it shall be possible to navigate the map including pan and zoom, and the map's moves shall be synchronized between all screens. Spanning the map over multiple screens must provide the same command and control capabilities than in a single screen display.

D. The DGM shall support the following file format and protocol for importing map background:

1. PDF
2. JPG
3. PNG
4. Web Map Tile Service (WMTS) and Web Map Service (WMS) defined by the Open Geospatial Consortium (OGC)
5. BeNomad
6. AutoCAD (DWG & DXF)

E. The DGM shall provide the following online map providers for use as map background and provide the ability to manage their service license if they require one:

1. Google Map, aerial, terrain (Licensed)
2. Bing Map, aerial, satellite, hybrid (Licensed)
3. ESRI ArcGIS (Licensed)
4. OpenStreet Map aerial (Licensed)
5. OVI hybrid

F. It shall be possible to configure a mixed set of maps made of GIS, online providers, and private imported files and link them together.

G. The DGM shall provide the ability to display all native entities of the USP including:

1. Cameras, fix, and PTZ
2. Doors
3. Camera sequences
4. Areas
5. Intrusion areas
6. Intrusion zones
7. License Plate Recognition cameras
8. Digital inputs
9. Digital outputs
10. Intercoms
11. Alarms
12. Macros
13. Police Car Patrollers

H. The DGM shall provide the ability to draw and display information over the map in the form of:

1. Vectoral shapes: line, rectangles, polygons, ellipse
2. Pictures
3. Text

I. The DGM shall provide the ability to display any type of third party entities integrated through an SDK.

J. The DGM shall provide the ability to display layer of information in Keyhole Markup Language (KML) format.

K. The DGM shall provide the ability to the operator to manage layers of entities display over the map, being able to turn them on and off and changing the superposition order.

L. The DGM shall provide the ability to import data layers from one or more ESRI ArcGIS servers.

M. The DGM shall provide the operators with the ability to manage layers that are imported from ESRI ArcGIS. The operators shall be able to turn the layers on and off, as well as sort the layer.

N. The DGM shall offer built-in map data backup and restore for both map background and layers of entities.

O. The DGM shall provide the ability to import configurations from an external file such as:

1. AutoCAD layer for objects
2. CSV, Excel file

P. The DGM shall offer failover capabilities.

Q. The DGM shall scale up to several thousands of entities on a single map and hundreds of maps.

R. The DGM shall provide a means to update a map background without affecting the map object configuration.

S. The DGM shall offer a user-friendly graphical map designer to configure the maps.

T. The DGM shall provide a user friendly and intuitive navigation that includes:

1. The ability to create hierarchies of maps to facilitate navigation within and between various sites and buildings.
2. The ability to define favorites for recurrent position recall.
3. The possibility to create links between maps. The map links shall allow the link from one map to multiple maps representing the floors of a building. Navigating between floor of a building shall keep the zoom level of the map.
4. A common user experience regarding navigation into the map for both GIS and private maps

U. It shall be possible to monitor the state of entities on the map. It shall be possible to customize the icons of any entities represented on the map.

V. The DGM shall offer the ability to optionally set a graphical display notification of the motion detection.

W. The DGM shall offer a smart selection tool to access the video. By clicking the location the user wants to see, the DGM will automatically select the cameras that can see this location and move the PTZ towards that location. This smart selection tool shall take into consideration the obstacle and not display cameras that cannot see the location because of a wall.

X. It shall be possible to select a location by drawing a zone of interest on the DGM and display all the entities that are part of that zone of interest at once.

Y. The user shall be able to select and display the content of multiple USP entities on the map in popup windows.

Z. The user shall be able to move, resize, and pin the USP entity pop-up windows to the map.

AA. It shall be possible to access live and playback video from the map.

BB. It shall be possible to monitor from the DGM all entities event notification. User shall be able to turn on and off the notification per entity.

CC. The DGM shall offer the ability to fully operate alarm monitoring. It shall be possible to:

1. Center the map on entities related to the alarm.
2. Visualize the Alarms notification on the map and access the related video from the map.
3. Trigger and receive alarms.
4. Act on the alarm from the DGM, including acknowledgements, forwarding, and investigation.

5. Visualize that an alarm occurred in an underlying linked map.

DD. The DGM shall provide the following search capabilities:

1. Search and center by entity name.

2. From the Display of an entity in the USP, locate the entity on the map and offer the ability to select another one close-by.

3. By street address, city, landmark, point of interest (using geocoder license from Google, ESRI, or other provider).

EE. Any update of map content by an administrator shall be immediately and dynamically pushed to all DGM users.

FF. The DGM shall support the use of GIS maps, private maps, or a combination of both or map background.

GG. The DGM shall be compatible with any GIS compliant maps with the OGC and supporting WMTS and WMS. This includes, but is not limited to, ESRI maps. The DGM shall allow the selection of the appropriate GIS layers.

HH. The DGM shall provide an intuitive build-in map designer for entity positioning on the map using drag and drop. Any configuration shall be graphic.

II. It shall be possible to edit and configure multiple map objects at once.

JJ. All map design modifications shall be logged in an audit trail.

KK. Various actions shall be available within maps for execution through simple and intuitive double-click, right-click, or drag-and-drop functionality. Examples of actions available through maps shall include unlocking a door and acknowledging an alarm.

LL. Through the following functionalities, the DGM shall allow the management of USP alarms for the map:

1. Locate on the map entities related to the alarm.

2. Display entities of the alarm with a specific icon, color, transparency level, and blinking rate.

3. List, select, and locate alarms.

4. Auto center the map on the highest priority alarm.

5. Handle the alarm from the map, including acknowledgement, forwarding, and investigation.

6. All map containers, such as hotspots or map links, shall reflect the alarm status of the contained entities.

MM. It shall be possible to add advanced functionality to map objects using the SDK. Any functionality available through the USP SDK shall be available within maps.

NN. The DGM shall offer lasso tools for:

1. Displaying entities at one location through a single action.

2. Triggering an action on all entities at one location in a single click.

3. Editing multiple entities at one location simultaneously.

OO. The DGM shall allow the display of USP entities selected from the map on a remote monitor (video wall).

PP. The DGM shall provide the ability to search within the map by entity name.

QQ. The DGM shall allow the use of KML overlay map information for both GIS and private maps. Moveable objects shall be supported using KML.

RR. The Contractor shall provide licenses for each entity that is required to be shown on the graphical maps.

2.29 USP AUDIT AND USER ACTIVITY TRAILS (LOGS)

A. The USP shall support the generation of audit trails. Audit trails shall consist of logs of operator/administrator additions, deletions, and modifications.

B. Audit trails shall be generated as reports. They shall be able to track changes made within specific time periods. Querying on specific users, changes, affected entities, and time periods shall also be possible.

C. For entity configuration changes, the audit trail report shall include detailed information of the value before and after the changes.

D. The USP shall support the generation of user activity trails. User activity trails shall consist of logs of operator activity on the USP such as login, camera viewed, ALPR event viewed, badge printing, video export, and more.

E. The ACS shall support the following actions on an audit and activity trail report: print report and export report to a PDF/ Microsoft Excel/CSV file.

2.30 USP INCIDENT REPORTS

A. Incident reports shall allow the security operator to create reports on incidents that occurred during a shift. Both video-related and access control-related incident reports shall be supported.

B. The operator shall be able to create standalone incident reports or incident reports tied to alarms.

C. The operator shall be able to link multiple video sequences to an incident, access them in an incident report, and change the date or time of the sequences later on.

D. It shall be possible to create a list of Incident categories, tag a category to an incident, and filter the search with the category as a parameter.

E. Incident reports shall allow the creation of a custom form on which to input information on an incident.

F. Incident reports shall allow entities, events, and alarms to be added to support at the report's conclusions.

2.31 USP DATA INGESTION

A. The USP shall allow the possibility to import external data from outside sources to enhance unification of data sources within the USP.

B. Each data source shall be defined by a set of fields and field types that describe the data source. Field types shall be:

1. String
2. 32-bit & 64-bit integer
3. Floating point number
4. Boolean
5. Timestamp
6. Binary (in a file or base 64)

C. The visualization of each data point from a data source shall be configurable to determine what fields from the data should be displayed. The configuration of each field should be:

1. Which fields are displayed or hidden
2. What order are the fields displayed
3. A label to specify the name of the field (to have a key:value format)
4. An option to specify how to display the field (text value, image, clipboard value, hyperlink to a web page, hyperlink to an entity in the system, sound file)

D. A privilege should be available for each data source to allow / deny access to specific users and user groups of the USP.

E. Ingested data shall be available in the USP reporting system.

F. Ingested data shall be available to display in the USP Dashboards.

2.32 USP THIRD PARTY INTEGRATION

A. Microsoft Active Directory Integration

1. The USP shall support a direct connection to one or multiple Microsoft Active Directory server via the Active Directory Role(s). Active Directory integration shall enable the synchronization of information from the Active Directory server to the USP.
2. Active Directory integration shall permit the central management of the USP users, user groups, cardholders, and cardholder groups.
3. The USP shall be able to connect to and synchronize data from multiple Active Directory servers (up to 10).
4. The USP shall support synchronizing Active Directory Universal Groups as well as security groups belonging to other domains within the same forest.
5. The USP shall support Microsoft Active Directory encryption using LDAP SSL.

6. When enabled, Active Directory shall manage user logon to the USP client applications through the user's Windows credentials. Logging to the USP shall utilize native Active Directory password management and authentication features.

7. It shall be possible to synchronize the following USP entities and their information from Active Directory with the USP:

    a. Users (username, first and last names, email address, and more).

    b. User groups (user group name, description, and group email address).

    c. Active Directory attributes to USP custom fields.

8. When enabled, the addition, removal, or suspension of a user's Windows account in Active Directory shall result in the creation, deletion, or disabling of the equivalent user account in the USP.

9. Supported synchronization methods for additions, modification, and deletions of synchronized entities shall include on first logon (users only), manual synchronization, and scheduled synchronization.

10. The USP shall support user connections across independent organizations by connecting to an external identity provider using claims-based authentication such as ADFS (Active Directory Federation Services), Azure Active Directory, other OpenID Connect & SAML2 providers.

B. Intrusion Detection Integration

1. The USP shall integrate with third party intrusion panels and devices via an Intrusion SDK. The Intrusion Manager Role shall manage communications with the intrusion panels. Communications with intrusion devices shall be over serial communications and/or an IP network.

2. Integration with intrusion panels shall be possible outside the release cycle of the USP. It shall be possible to add new integrations at any point in time.

3. Functionality available via the integration of intrusion devices with the USP shall include the following (where supported by the intrusion panel):

    a. Arm and disarm intrusion devices (manually, on schedule, or following a USP event).

    b. Activate or trigger intrusion device outputs.

    c. View intrusion events and alarms.

    d. Monitor the status, including arming status, of the intrusion devices.

    e. Video verification of intrusion events and alarms with video panels.

    f. Create USP zones using intrusion device inputs.

4. Currently supported intrusion panels include:

    a. Bosch G Series panels

    b. Bosch Map 5000

    c. DSC Power Series panels

    d. DMP XR Series panels

e. Honeywell Galaxy Dimension and Flex panels

f. Vanderbilt SPC

g. UTC Advisor Master and Advanced

5. Additional Intrusion devices supported include:

a. Buytime

b. Alarm Panel Receiver

c. Southwest Microwave RPMII

C. Third Party Access Control Systems

1. The USP shall integrate with third party access control software via the SDK. Communications with access control software shall be over an IP network, and should not support administrative tasks such as cardholder management.

2. Integration with access control software shall be possible outside the release cycle of the USP. It shall be possible to add new integrations at any point in time.

3. Functionality available via the integration of access control software with the USP shall include the following (where supported by the access control solution):

a. Synchronize access control entities and receive associated events and states within the USP, including:

1) Cardholders and access rights

2) Visitors

3) Readers and doors

4) Alarms

5) Inputs and outputs

b. Monitor access control events.

c. Monitor and Acknowledge access control alarms.

d. Trigger actions and outputs in the access control software using hot actions and event-to-actions.

e. Lock and unlock doors in the access control software.

f. Video verification of access control events and alarms.

g. Configure event-to-actions using the access control events and alarms.

h. Generate Security Center reports using from the in the access control data.

i. View and monitor states of door entities in the USP maps.

4. Currently supported access control manufacturers include:

a. Tyco Softwarehouse CCURE

b. UTC Lenel Onguard

c. Amag Symmetry

d. Siemens Sipass

e. AssaAbloy ARX

D. Third Party Destination Dispatch Systems:

1. The USP shall integrate with third part destination dispatch (elevator control0 software via the SDK. Communications with the destination dispatch software shall be over an IP network.

2. Integration with destination dispatch software shall be possible outside the release cycle of the USP. It shall be possible to add new integrations at any point in time.

3. Functionality available via the integration of destination dispatch software with the USP shall include the following (where supported by the destination dispatch solution):

a. Destination dispatch entity creation and reception of associated events and states within the USP, including:

1) Floors and landings

2) Elevator cars (front/rear doors) and kiosks

3) Cardholders and credentials (if applicable)

b. Monitor destination dispatch events.

c. Trigger manual dispatch actions.

d. Video verification of destination dispatch events.

e. Configure event-to-actions using the destination dispatch events.

f. Generate Security Center reports using the destination dispatch data.

g. Support multiple readers:

1) Kiosk internal readers

2) USP readers

h. Kiosk advanced modes and passenger types.

4. Currently supported destination dispatch manufacturers include:

a. Otis Compass

b. Thyssenkrupp

c. Schindler

d. MCE

E. Asset Management Integration

1. The USP shall integrate with third party asset management systems via the Asset Management Role.

2. Communications with asset management solutions shall be over an IP network (via software communications).

3. Functionality available via the integration of asset management systems with the USP shall include the following (where supported by the asset management systems):
    a. Synchronize asset management system assets with USP asset entities.
    b. Live monitoring of asset-related activity events, health events, and activity (asset online, asset offline, asset moves, or low battery).
    c. Synchronization of asset management alarms with Security Center alarms.
    d. Viewing video tied to asset-related activity and alerts within monitoring and reporting tasks.
    e. Acknowledging alarms in Security Center which acknowledges alerts in the asset management system and vice versa.
    f. Real-time tracking of asset locations on a per area basis.
    g. Asset Management Inventory reporting task that details the current location (area) of an asset.
    h. Asset Activity reporting task that provides a historical review of asset-related events and activity.
4. Currently supported asset management systems include:
    a. Deister Key management
    b. Morsewatchmans
    c. TRAKA

F. Additional Third Party Integrations

1. The USP shall support multiple approaches to integrating third party systems. These shall include: Software Development Kits (SDKs), REST-based Web Service SDKs, RTSP Service SDKs, and more.
2. The USP architecture shall support the addition of new connectors to integrate to third party system integration, such as:
    a. Video analytics
    b. Third party video systems
    c. Third party access control systems
    d. ALPR integrations with pay stations, permit vendors, pay-by-phone vendors, and ticketing vendors
    e. Building management systems
    f. Access Control ecosystem (such as ID scanner, card synchronization, Guardtour, Morpho Biometrics)
    g. Transaction monitoring (POS, Barcode scanning, ATM)
    h. Industrial IoT (Modbus, BACnet, OPC, SNMP)
    i. Industrial Protocol Interface (BACnet, Modbus)

j. Videowall (Barco, Eizo)

k. Human resource management systems (HRMS)

l. Autonomous Drone Integration

m. Intelligent Keys (Salto SVN, Medeco XT, CLIQ)

n. Gunshot Detection (Shot Spotter, Guardian GunShot)

o. Dynamic Logbook

p. Facial Recognition Framework

q. Real-time Location Services - RTLS (HID)

2.33 USP SOFTWARE DEVELOPMENT KIT (SDK)

A. A USP SDK shall be available to support custom development for the platform.

B. The SDK shall include functionalities specific to the embedded automatic license plate recognition (ALPR), access control (ACS), and video (VMS) systems.

C. Integration with external applications and databases shall be possible with the SDK.

D. The SDK shall enable end-users to develop new functionality (user interface, standalone applications or services) to link the USP to third party business systems and applications, such as Badging Systems, Human Resources Management Systems (HRMS), and Enterprise Resource Planning (ERP) systems.

E. The SDK shall be based on the .NET framework.

F. The SDK shall support dynamic or transactional updates to the USP configuration. It shall also support change notification of USP entity configuration.

G. The SDK shall provide an extensive list of programming functions to view and/or configure core entities such as: users and user groups, alarms, custom events, and schedules, and more.

H. The SDK shall provide an extensive list of programming functions to view and configure ACS, VMS, and ALPR.

I. The SDK shall provide an extensive list of programming functions to view and configure most ACS entities such as: cardholders, cardholder groups, visitors, credentials, access rules (modify only), and custom fields.

J. The SDK shall be able to receive real time events from the following USP entities: users and user groups, areas, zones, cameras, video units, doors, door controllers (units), elevators, cardholders, cardholder groups, and credentials.

K. The SDK shall be able to query the history of events for areas, cameras, zones, alarms, cardholders, credentials, visitors, doors, query license plate read events, license plate hit events, generate a license plate hits report, generate a license plate reads report.

L. The SDK shall support the following alarm functions: view alarms in real time, acknowledge alarms, change priority, and change recipient.

PART 3 - EXECUTION

3.1 WARRANTY

A. The product shall perform in all material respects in accordance with the accompanying user manual, and the media on which the Software Product resides will be free from defects in materials and workmanship under normal use. Software defects are covered through Service Releases and Cumulative Updates which are available for a period of 1 year from the date of the software purchase.

B. Extended warranty, up to 5 years, shall be available through the purchase of a software maintenance agreement (SMA) which includes the following additional services over the standard warranty:

1. Access to phone support and online chat for technical assistance.
2. Online case management.
3. Online system availability monitor.
4. Access to Major and Minor Release Upgrades.
5. 24/7 pager support and dedicated support specialist.

3.2 DEPLOYMENT SERVICES AND SYSTEM COMMISSIONING

A. General Requirements

1. The contractor shall engage the services of the USP vendor to assist in the management of the deployment of the USP at the end-user site on projects that involve:
    a. Multiple contractors or subcontractors that will be responsible for deploying the USP at multiple client sites in different geographical regions.
    b. Complex enterprise installations involving advanced functionality (for example The Federation feature, failover, plugins) and/or multiple systems (for example access control, video, ALPR) and/or third party integrations.
    c. Extensive use of customized solutions/plugins developed by the vendor that will be integrated into the USP.
2. The USP vendor services shall include Deployment Management and System Configuration and Commissioning.

B. Deployment Management Service

1. The Deployment Management service from the vendor shall include a Project Manager acting as the single point of contact for all communications between the contractor and the vendor organization and who will be responsible for:
    a. Conducting a Risk Assessment of the impact of potential risk factors on the operation of the vendor's USP.
    b. Providing a project plan for the deployment of the vendor's USP.
    c. Managing the development and deployment of the custom solution components that will be integrated into the vendor's USP (if applicable).

d. Providing a scope of work detailing the services to be provided by the vendor to assist in the deployment of the vendor's USP.

e. Coordinating and scheduling the vendor field services with the contractor to assist with the deployment of the vendor's USP.

f. Providing regular project status updates to the contractor regarding the development of custom solutions (if applicable) and the deployment of the vendor's USP.

C. Solution Architect Service

1. The Solution Architect service from the vendor shall include a Solutions Architect Engineer acting as a single technical point of contact throughout the deployment of the USP, and who will be responsible for:

a. Assisting the contractor/subcontractor with the design and architecture of the vendor's USP.

b. Conducting technical consultation activities that may include fit/gap analysis, system design reviews, device compatibility assessments, functional and technical design reviews as well as performance reviews of the vendor's USP.

c. Conducting a system assessment and ensuring best practices of the vendor's USP are followed.

d. Providing upgrade and migration strategy for the vendor's USP where applicable.

e. Providing documentation regarding the system architecture, system design, hardware specifications and compatibility requirements, camera bandwidth calculations, and best practices as they relate to the vendor's USP.

D. System Configuration and Commissioning Service

1. The System Configuration and Commissioning service from the vendor shall include a Field Engineer who will be responsible for:

a. Assisting the contractor's or subcontractor's onsite/remote technicians with the configuration and commissioning of the vendor's USP at the client site.

b. Conducting a test of the USP following the deployment of the system using real-world operator scenarios to ensure optimal system performance.

c. Providing the contractor with a Service Report detailing the tasks completed during the deployment of the USP at the client site, as well as any recommendations for improving the performance of the USP that must be implemented by the contractor.

d. Providing a knowledge transfer of the vendor's USP to the contractor following the deployment of the USP at the client site.

3.3 MANUFACTURER END USER OPERATOR TRAINING

A. The contractor shall engage the services of the USP vendor to assist in the end user training of the USP at the end-user site.

END OF SECTION

PROJECT MANUAL FOR CONSTRUCTION OF

SUPREME COURT OF MARYLAND

Rowe Boulevard
Annapolis, MD
Anne Arundel County
DGS Project #BA-688-200-001
Project Classification H

PROJECT SPECIFICATIONS

Volume 4 of 4: Divisions 31 - 33

Issue for Bid
December 1, 2023

DEPARTMENT OF GENERAL SERVICES
Atif Chaudhry, Secretary
301 West Preston Street, Room 1405
Baltimore, MD 21201

Board of Public Works
Wes Moore, Governor
Brooke Elizabeth Lierman, Comptroller
Dereck E. Davis, Treasurer

Maryland
DEPARTMENT OF GENERAL SERVICES

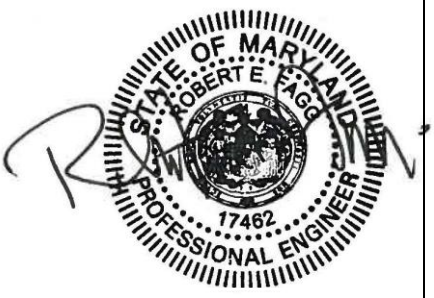
SUPREME COURT OF MARYLAND

FENTRESS ARCHITECTS

"Minority Business Enterprises are encouraged to respond to this solicitation."

This page is intentionally left blank.

SECTION 00 01 07 - SEALS PAGE

		
ARCHITECT OF RECORD	CIVIL ENGINEER	STRUCTURAL ENGINEER
 12/1/2023	 12/1/2023	 12/1/2023
FIRE PROTECTION	PLUMBING ENGINEER	MECHANICAL ENGINEER
 12/1/2023	 12/1/2023	
ELECTRICAL ENGINEER	TECHNOLOGY & AV ENGINEER	LANDSCAPE ARCHITECT

END OF SEALS PAGE

This page is intentionally left blank.

SECTION 00 01 10 - TABLE OF CONTENTS

Issue No.	**Issue Title**	**Issue Date**
Issue 1:	Issue for Bid	December 1, 2023

Legend:
X = First Issue for Bid
O = Reissue (unchanged)
R = Revised for this Package
W = Withdrawn
-- = Not Reissued for this Package

SECTION NUMBER	SECTION TITLE	Author	ISSUE NUMBER							
			1	2	3	4	5	6	7	8
DIVISION 00 - PROCUREMENT AND CONTRACTING REQUIREMENTS										
00 01 07	Seals Page	FA	X							
00 01 10	Table of Contents	FA	X							
DIVISION 00 – PROCUREMENT AND CONTRACTING REQUIREMENTS										
Division 00	Procurement and Contracting Requirements	DGS	X							
DIVISION 01 - GENERAL REQUIREMENTS										
01 10 00	Summary	FA	X							
01 21 00	Allowances	FA	X							
01 22 00	Unit Prices	FA	X							
01 23 00	Alternates	FA	X							
01 25 00	Substitution Procedures	FA	X							
01 26 00	Contract Modification Procedures	FA	X							
01 29 00	Payment Procedures	FA	X							
01 31 00	Project Management and Coordination	FA	X							
01 31 00A	Digital Data Licensing and Indemnification Exhibit – Appendix A	FA	X							
01 32 00	Construction Progress Documentation	FA	X							

SECTION NUMBER	SECTION TITLE	Author	ISSUE NUMBER							
			1	2	3	4	5	6	7	8
01 33 00	Submittal Procedures	FA	X							
01 40 00	Quality Requirements	FA	X							
01 42 00	References	FA	X							
01 43 39	Mockups	FA	X							
01 50 00	Temporary Facilities and Controls	FA	X							
01 50 10	Temporary Facilities and Controls - State Field Office	FA	X							
01 56 39	Temporary Tree and Plant Protection	AMT	X							
01 60 00	Product Requirements	FA	X							
01 73 00	Execution	FA	X							
01 74 19	Construction Waste Management and Disposal	FA	X							
01 74 19 EVA	Form CWM-1: Construction Waste Identification	FA	X							
01 74 19 EVB	Form CWM-2: Demolition Waste Identification	FA	X							
01 74 19 EVC	Form CWM-3: Construction Waste Reduction Work Plan	FA	X							
01 74 19 EVD	Form CWM-4: Demolition Waste Reduction Work Plan	FA	X							
01 74 19 EVE	Form CWM-5: Cost/Revenue Analysis of Construction Waste Reduction Work Plan	FA	X							
01 74 19 EVF	Form CWM-6: Cost/Revenue Analysis of Demolition Waste Reduction Work Plan	FA	X							
01 74 19 EVG	Form CWM-7: Construction Waste Reduction Progress Report	FA	X							
01 74 19 EVH	Form CWM-8: Demolition Waste Reduction Progress Report	FA	X							
01 77 00	Closeout Procedures	FA	X							
01 78 23	Operation and Maintenance Data	FA	X							
01 78 39	Project Record Documents	FA	X							
01 79 00	Demonstration and Training	FA	X							
01 81 13.14	Sustainable Design Requirements – LEED v4 BD+C, New Construction	FA	X							
01 81 13.14A	LEED Matrix - Appendix A	FA	X							

SECTION NUMBER	SECTION TITLE	Author	ISSUE NUMBER							
			1	2	3	4	5	6	7	8
01 81 13.14B	LEED Scorecard - Appendix B	FA	X							
01 81 13.14C	LEEDv4.1 Materials Submittal Form - Appendix C	FA	X							
01 91 13	General Commissioning Requirements [to be provided at later date]	DGS								
DIVISION 02 – EXISTING CONDITIONS										
02 41 19	Selective Demolition	FA	X							
DIVISION 03 – CONCRETE										
03 10 00	Concrete Forming and Accessories	HFA	X							
03 30 00	Cast-in-Place Concrete	HFA	X							
03 45 00	Precast Architectural Concrete	FA	X							
DIVISION 04 – MASONRY										
04 01 40.99	Relocation Reuse and Restoration of Latrobe Marble Columns	FA	X							
04 22 00	Concrete Unit Masonry	FA	X							
DIVISION 05 – METALS										
05 05 19	Post Installed Anchors	HFA	X							
05 12 00	Structural Steel Framing	HFA	X							
05 31 00	Steel Decking	HFA	X							
05 40 00	Cold-Formed Metal Framing	FA	X							
05 50 00	Metal Fabrications	FA	X							
05 51 13	Metal Pan Stairs	FA	X							
05 51 19	Metal Grating Stairs	FA	X							
05 52 13	Pipe and Tube Railings	FA	X							

SECTION NUMBER	SECTION TITLE	Author	ISSUE NUMBER							
			1	2	3	4	5	6	7	8
05 53 13	Bar Gratings	HFA	X							
05 58 13	Column Covers	FA	X							
05 70 00	Decorative Metal	FA	X							
05 71 00	Decorative Metal Stairs	FA	X							
05 73 00	Decorative Metal Railings	FA	X							
05 73 13	Glazed Decorative Metal Railings	FA	X							
05 75 00	Decorative Formed Metal	FA	X							
DIVISION 06 – WOOD, PLASTICS, AND COMPOSITES										
06 01 40.99	Relocation, Reuse, and Restoration of Historic Courtroom Woodwork	FA	X							
06 10 00	Rough Carpentry	FA	X							
06 16 00	Sheathing	FA	X							
06 40 23	Interior Architectural Woodwork	FA	X							
06 41 13	Wood-Veneer-Faced Architectural Cabinets	FA	X							
06 41 16	Plastic-Laminate-Clad Architectural Cabinets	FA	X							
06 42 14	Stile and Rail Wood Paneling	FA	X							
06 44 00	Ornamental Woodwork	FA	X							
06 64 00	Plastic Paneling	FA	X							
06 83 13	Fiber-Reinforced Plastic Paneling	FA	X							
DIVISION 07 – THERMAL AND MOISTURE PROTECTION										
07 05 43.13	Rainscreen Cladding Support Systems	FA	X							
07 11 13	Bituminous Dampproofing	FA	X							
07 13 26	Self-Adhering Sheet Waterproofing	FA	X							
07 14 13	Hot Fluid-Applied Rubberized Asphalt Waterproofing	FA	X							

SECTION NUMBER	SECTION TITLE	Author	ISSUE NUMBER							
			1	2	3	4	5	6	7	8
07 16 16	Crystalline Waterproofing	FA	X							
07 18 00	Traffic Coatings	FA	X							
07 19 00	Water Repellents	FA	X							
07 21 00	Thermal Insulation	FA	X							
07 21 19	Foamed-In-Place Insulation	FA	X							
07 27 13	Modified Bituminous Sheet Air Barriers	FA	X							
07 42 13.13	Formed Metal Wall Panels	FA	X							
07 54 19	Polyvinyl-Chloride (PVC) Roofing	FA	X							
07 62 00	Sheet Metal Flashing and Trim	FA	X							
07 72 00	Roof Accessories	FA	X							
07 72 73	Vegetated Roof Systems	FA	X							
07 81 00	Applied Fire Protection	FA	X							
07 84 13	Penetration Firestopping	FA	X							
07 84 43	Joint Firestopping	FA	X							
07 92 00	Joint Sealants	FA	X							
07 92 19	Acoustical Joint Sealants	FA	X							
DIVISION 08 – OPENINGS										
08 11 13	Hollow Metal Doors and Frames	FA	X							
08 14 16	Flush Wood Doors	FA	X							
08 14 33	Stile and Rail Wood Doors	FA	X							
08 31 13	Access Doors and Frames	FA	X							
08 33 23	Overhead Coiling Doors	FA	X							
08 33 43	Overhead Coiling Smoke Curtains	FA	X							
08 41 26.23	Interior All-Glass Entrances	FA	X							

SECTION NUMBER	SECTION TITLE	Author	ISSUE NUMBER							
			1	2	3	4	5	6	7	8
08 44 13	Glazed Aluminum Curtain Walls	FA	X							
08 56 53	Security Windows	FA	X							
08 63 00	Metal-Framed Skylights	FA	X							
08 71 00	Door Hardware	DMK/FA	X							
08 71 13	Power Door Operators	FA	X							
08 75 16	Window Operators	FA	X							
08 80 00	Glazing	FA	X							
08 81 13	Decorative Glass Glazing	FA	X							
08 83 00	Mirrors	FA	X							
08 88 53	Security Glazing	FA	X							
08 91 19	Fixed Louvers	FA	X							
DIVISION 09 – FINISHES										
09 05 61.13	Moisture Vapor Emission Control	FA	X							
09 21 16.23	Gypsum Board Shaft Wall Assemblies	FA	X							
09 22 16	Non-Structural Metal Framing	FA	X							
09 23 13	Acoustical Gypsum Plastering	FA	X							
09 24 00	Cement Plastering	FA	X							
09 27 13	Glass-Fiber-Reinforced Gypsum Fabrications	FA	X							
09 29 00	Gypsum Board	FA	X							
09 30 13	Ceramic Tiling	FA	X							
09 51 13	Acoustical Panel Ceilings	FA	X							
09 64 00	Wood Flooring	FA	X							
09 65 13	Resilient Base and Accessories	FA	X							
09 65 19	Resilient Tile Flooring	FA	X							

SECTION NUMBER	SECTION TITLE	Author	ISSUE NUMBER							
			1	2	3	4	5	6	7	8
09 65 36	Static-Control Resilient Flooring	FA	X							
09 65 66	Resilient Athletic Flooring	FA	X							
09 66 23	Resinous Matrix Terrazzo Flooring	FA	X							
09 68 13	Tile Carpeting	FA	X							
09 75 13	Stone Wall Facing	FA	X							
09 75 23	Simulated Stone Wall Facing	FA	X							
09 84 33	Sound-Absorbing Wall Units	FA	X							
09 91 23	Interior Painting	FA	X							
09 96 11	High-Performance Coatings (Proprietary Specification)	FA	X							
DIVISION 10 – SPECIALTIES										
10 12 00	Display Cases	FA	X							
10 14 00	Signage	FA	X							
10 21 13.17	Phenolic-Core Toilet Compartments	FA	X							
10 22 13	Wire Mesh Partitions	FA	X							
10 22 39	Folding Panel Partitions	FA	X							
10 26 00	Wall and Door Protection	FA	X							
10 26 41	Bullet Resistant Panels	FA	X							
10 28 00	Toilet, Bath, and Laundry Accessories	FA	X							
10 43 13	Defibrillator Cabinets	FA	X							
10 44 13	Fire Protection Cabinets	FA	X							
10 44 16	Fire Extinguishers	FA	X							
10 45 13	Photoluminescent Egress Path Markings	FA	X							
10 51 13	Metal Lockers	FA	X							
10 51 16	Wood Lockers	FA	X							

SECTION NUMBER	SECTION TITLE	Author	ISSUE NUMBER							
			1	2	3	4	5	6	7	8
10 51 23	Plastic-Laminate-Clad Lockers	FA	X							
10 56 26	Mobile Storage Shelving	FA	X							
10 81 13	Bird Control Devices	FA	X							
DIVISION 11 – EQUIPMENT										
11 12 00	Vehicle Access Control Systems	M2H	X							
11 13 19	Stationary Loading Dock Equipment	FA	X							
11 19 16	Detention Gun Lockers	FA	X							
11 30 13	Residential Appliances	FA	X							
11 81 31	Facility Fall Protection and Facade Access Equipment	FA	X							
11 81 33	Mobile Scissor Lifts	FA	X							
DIVISION 12 – FURNISHINGS										
12 24 13	Roller Window Shades	FA	X							
12 36 23.13	Plastic-Laminate-Clad Countertops	FA	X							
12 36 61.19	Quartz Agglomerate Countertops	FA	X							
12 93 00	Site Furnishings	RHI	X							
DIVISION 14 – CONVEYING EQUIPMENT										
14 21 23.16	Machine Room-Less Electric Traction Passenger Elevators	FA	X							
14 27 00	Custom Elevator Cabs and Doors	FA	X							
DIVISION 21 – FIRE SUPPRESSION										
21 05 00	Common Work Results For Fire Suppression	ME-E	X							
21 08 00	Commissioning Of Fire Suppression System	ME-E	X							

SECTION NUMBER	SECTION TITLE	Author	ISSUE NUMBER							
			1	2	3	4	5	6	7	8
21 13 00	Fire Suppression Sprinkler Systems	ME-E	X							
21 13 19	Preaction Suppression Systems	ME-E	X							
21 90 00	Fire Suppression System Project Closeout	ME-E	X							
DIVISION 22 – PLUMBING										
22 00 00	Basic Plumbing Requirements	WFT	X							
22 05 13	Common Motor Requirements for Plumbing Equipment	WFT	X							
22 05 16	Expansion Fittings and Loops for Plumbing Piping	WFT	X							
22 05 17	Sleeves and Sleeve Seals for Plumbing Piping	WFT	X							
22 05 18	Escutcheons for Plumbing Piping	WFT	X							
22 05 19	Meters and Gages for Plumbing Piping	WFT	X							
22 05 23.12	Ball Valves for Plumbing Piping	WFT	X							
22 05 23.13	Butterfly Valves for Plumbing Piping	WFT	X							
22 05 23.14	Check Valves for Plumbing Piping	WFT	X							
22 05 23.15	Gate Valves for Plumbing Piping	WFT	X							
22 05 29	Hangers and Supports for Plumbing Piping and Equipment	WFT	X							
22 05 48.13	Vibration Controls for Plumbing Piping and Equipment	WFT	X							
22 05 53	Identification for Plumbing Piping and Equipment	WFT	X							
22 05 93	Testing, Adjusting, and Balancing for Plumbing	WFT	X							
22 07 16	Plumbing Equipment Insulation	WFT	X							
22 07 19	Plumbing Piping Insulation	WFT	X							
22 11 16	Domestic Water Piping	WFT	X							
22 11 19	Domestic Water Piping Specialties	WFT	X							
22 11 23.13	Domestic Water Packaged Booster Pumps	WFT	X							
22 11 23.21	Inline, Domestic-Water Pumps	WFT	X							

SECTION NUMBER	SECTION TITLE	Author	ISSUE NUMBER							
			1	2	3	4	5	6	7	8
22 12 23.11	Facility Indoor Potable Water Storage Tanks	WFT	X							
22 13 13	Facility Sanitary Sewers	AMT	X							
22 13 16	Sanitary Waste and Vent Piping	WFT	X							
22 13 19	Sanitary Waste Piping Specialties	WFT	X							
22 13 19.13	Sanitary Drains	WFT	X							
22 13 23	Sanitary Waste Interceptors	WFT	X							
22 14 13	Facility Storm Drainage Piping	WFT	X							
22 14 23	Storm Drainage Piping Specialties	WFT	X							
22 14 29	Sump Pumps	WFT	X							
22 32 00	Domestic Water Filtration Equipment	WFT	X							
22 33 00	Electric, Domestic-Water Heaters	WFT	X							
22 42 13.13	Commercial Water Closets	WFT	X							
22 42 13.16	Commercial Urinals	WFT	X							
22 42 16.13	Commercial Lavatories	WFT	X							
22 42 16.16	Commercial Sinks	WFT	X							
22 42 23	Commercial Showers	WFT	X							
22 45 00	Emergency Plumbing Fixtures	WFT	X							
22 47 16	Pressure Water Coolers	WFT	X							
DIVISION 23 – HEATING, VENTILATING, AND AIR CONDITIONING (HVAC) *Refer To Alternates List For Applicable Sections										
23 05 01*	Mechanical and Electrical Coordination 23 05 01 and 26 05 01	ME-E	X							
23 05 02	Basic Mechanical Requirements	ME-E	X							
23 05 03	Basic Mechanical Materials and Methods	ME-E	X							
23 05 04	Corrosion Protection from Humid Salt-Laden Outdoor Air	ME-E	X							
23 05 13	Motors and Starters	ME-E	X							

SECTION NUMBER	SECTION TITLE	Author	ISSUE NUMBER							
			1	2	3	4	5	6	7	8
23 05 21	Pipe and Pipe Fittings	ME-E	X							
23 05 22	Piping Accessories	ME-E	X							
23 05 23	Valves	ME-E	X							
23 05 29	Pipe Supports and Anchors	ME-E	X							
23 05 30	Electronic Speed Controllers	ME-E	X							
23 05 48	Vibration Control	ME-E	X							
23 05 53	Mechanical Identification	ME-E	X							
23 05 93	Test-Adjust-Balance	ME-E	X							
23 07 00	Mechanical Insulation	ME-E	X							
23 08 00	Building Mechanical System Commissioning	ME-E	X							
23 08 01	Commissioning Agent Requirements	ME-E	X							
23 09 00	Building Automation and Automatic Temperature Control Systems	ME-E	X							
23 09 02	Life Safety Systems	ME-E	X							
23 09 03*	Smoke Management 23 09 03 and 28 46 10	ME-E	X							
23 21 13	Hydronic Piping	ME-E	X							
23 21 23	HVAC Pumps	ME-E	X							
23 23 00	Refrigerant Piping	ME-E	X							
23 25 13	HVAC System Chemical Treatment	ME-E	X							
23 31 13	Ductwork	ME-E	X							
23 33 00	Ductwork Accessories	ME-E	X							
23 34 00	Fans	ME-E	X							
23 36 00	Air Terminal Units	ME-E	X							
23 37 00	Air Inlets and Outlets	ME-E	X							
23 40 00	Air Cleaning	ME-E	X							
23 52 00	Boilers	ME-E	X							

SECTION NUMBER	SECTION TITLE	Author	ISSUE NUMBER							
			1	2	3	4	5	6	7	8
23 64 23	Air Cooled Scroll Heat Pump Water Chillers	ME-E	X							
23 73 13	Air Handling Units with Coil	ME-E	X							
23 73 24	Split System Dx Air Handling Units	ME-E	X							
23 81 23	Electronic Room Air Conditioning Unit	ME-E	X							
23 81 26	Split System Air Conditioners	ME-E	X							
23 81 29	Variable Refrigerant Flow HVAC Systems	ME-E	X							
23 82 16	Air Coils	ME-E	X							
23 82 19	Fan Coil Units	ME-E	X							
23 82 39	Heating Terminal Units	ME-E	X							
23 84 13	Humidifiers	ME-E	X							
23 90 00	Project Closeout	ME-E	X							
DIVISION 26 – ELECTRICAL *Refer To Alternates List For Applicable Sections										
26 05 00	Electrical Requirements	ME-E	X							
26 05 01*	Mechanical and Electrical Coordination 23 05 01 and 26 05 01	ME-E	X							
26 05 02	Basic Material and Methods	ME-E	X							
26 05 03	Manufacturers	ME-E	X							
26 05 10	Testing	ME-E	X							
26 05 19	Electrical Power Conductors and Cables	ME-E	X							
26 05 26	Grounding and Bonding	ME-E	X							
26 05 29	Hangers and Supports	ME-E	X							
26 05 33	Raceways and Boxes	ME-E	X							
26 05 43	Underground Ducts, Raceways and Manholes	ME-E	X							
26 05 48	Vibration and Seismic Controls	ME-E	X							

SECTION NUMBER	SECTION TITLE	Author	ISSUE NUMBER							
			1	2	3	4	5	6	7	8
26 05 53	Identification	ME-E	X							
26 05 73	Electrical Studies	ME-E	X							
26 09 13	Electrical Power Monitoring	ME-E	X							
26 09 36	Modular Dimming Controls	MCLA	X							
26 09 43	Lighting Control System	ME-E	X							
26 22 13	Low-Voltage Distribution Transformers	ME-E	X							
26 24 12	Utility Service Connection Cabinets	ME-E	X							
26 24 13	Distribution Switchboards	ME-E	X							
26 24 16	Panelboards	ME-E	X							
26 25 00	Enclosed Bus Assemblies	ME-E	X							
26 27 26	Wiring Devices	ME-E	X							
26 27 29	Electric Vehicle Charging Systems	ME-E	X							
26 28 16	Enclosed Switches, Fuses and Circuit Breakers	ME-E	X							
26 32 13	Diesel-Engine Driven Generator Sets	ME-E	X							
26 36 23	Automatic Transfer Switches	ME-E	X							
26 41 13	Lightning Protection for Structures	ME-E	X							
26 43 13	Surge Protective Device (SPD) (Selenium Enhanced)	ME-E	X							
26 43 14	Surge Protective Device (SPD)	ME-E	X							
26 51 00	Lighting Fixtures	MCLA	X							
26 56 13	Poles and Standards	ME-E	X							
26 90 00	Project Closeout	ME-E	X							
DIVISION 27 – COMMUNICATIONS										
27 05 00	Common Work Results for Communications	ME-E	X							
27 05 26	Telecommunications Grounding and Bonding	ME-E	X							

SECTION NUMBER	SECTION TITLE	Author	ISSUE NUMBER							
			1	2	3	4	5	6	7	8
27 05 33	Telecommunications Raceways and Boxes	ME-E	X							
27 05 36	Cable Trays	ME-E	X							
27 11 00	Communications Equipment Room Fit-Out	ME-E	X							
27 13 13	Communications Copper Backbone Cabling	ME-E	X							
27 13 23	Communications Optical Fiber Backbone Cabling	ME-E	X							
27 15 00	Communications Horizontal Cabling	ME-E	X							
27 41 00	Audio Visual Systems	ME-E	X							
27 53 20	Distributed Antenna Systems (DAS) General Requirements	ME-E	X							
DIVISION 28 – ELECTRONIC SAFETY AND SECURITY *Refer To Alternates List For Applicable Sections										
28 05 00.10	Common Work Results for Electronic Security	M2H	X							
28 05 09.10	Surge Protection for Electronic Security	M2H	X							
28 05 11	Cyber Security for Electronic Security	M2H	X							
28 05 13	Conductors and Cables for Electronic Security	M2H	X							
28 05 13.10	Servers, Workstations, and Storage for Electronic Security	M2H	X							
28 05 26.10	Grounding and Bonding for Electronic Security	M2H	X							
28 05 28.10	Pathways for Electronic Security	M2H	X							
28 05 29	Hangers and Supports for Communications Systems	M2H	X							
28 05 31.10	Communications Equipment for Electronic Security	M2H	X							
28 05 43	Underground Pathways for Elect Security	M2H	X							
28 05 44	Sleeves and Sleeve Seals for Electronic Security Pathways and Cabling	M2H	X							
28 08 00.10	Commissioning of Electronic Security	M2H	X							
28 11 16	Security Racks, Frames, and Enclosures	M2H	X							
28 13 00	Physical Access Control System	M2H	X							

SECTION NUMBER	SECTION TITLE	Author	ISSUE NUMBER							
			1	2	3	4	5	6	7	8
28 13 23	Optical Fiber Backbone Cabling for Electronic Security	M2H	X							
28 15 13	Security Copper Horizontal Cabling	M2H	X							
28 15 23	Intercom and Public Address Systems	M2H	X							
28 16 00	Intrusion Detection System	M2H	X							
28 23 00	Video Surveillance System	M2H	X							
28 46 00	Addressable Fire Alarm System	ME-E	X							
28 46 10*	Smoke Management 23 09 03 and 28 46 10	ME-E	X							
28 50 10	Area of Rescue Assistance System	ME-E	X							
28 50 20	Emergency Responder Radio System	ME-E	X							
28 51 00	Information Management & Presentation	M2H	X							
DIVISION 31 – EARTHWORK										
31 10 00	Site Clearing	AMT	X							
31 20 00	Earth Moving	AMT	X							
DIVISION 32 – EXTERIOR IMPROVEMENTS										
32 12 16	Asphalt Paving	AMT	X							
32 13 13	Concrete Paving	AMT	X							
32 13 13.33	Concrete Paving for Sidewalks	RHI	X							
32 13 73	Concrete Paving Joint Sealants	AMT	X							
32 13 73.33	Concrete Paving Joint Sealants for Sidewalks	RHI	X							
32 14 00	Unit Paving	FA	X							
32 17 13	Parking Bumpers	FA	X							
32 17 23	Pavement Markings	AMT	X							
32 17 26	Tactile Warning Surfacing	AMT	X							

SECTION NUMBER	SECTION TITLE	Author	ISSUE NUMBER							
			1	2	3	4	5	6	7	8
32 31 19	Decorative Metal Gates	FA	X							
32 91 15	Soil Preparation	RHI	X							
32 92 00	Lawns and Turfgrasses	RHI	X							
32 93 00	Exterior Plants	RHI	X							
32 96 00	Transplanting	RHI	X							
DIVISION 33 – UTILITIES										
33 14 15	Site Water Distribution Piping	AMT	X							
33 41 99	Stormwater Management	AMT	X							
33 42 00	Stormwater Conveyance	AMT	X							

END OF TABLE OF CONTENTS

SECTION 31 10 00 - SITE CLEARING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Protecting existing vegetation to remain.
2. Removing existing vegetation.
3. Clearing and grubbing.
4. Stripping and stockpiling topsoil.
5. Stripping and stockpiling rock.
6. Removing above- and below-grade site improvements.
7. Disconnecting, capping or sealing, and removing site utilities.
8. Temporary erosion and sedimentation control.

B. Related Requirements:

1. Section 015000 "Temporary Facilities and Controls" for temporary erosion- and sedimentation-control measures.

C. Related Requirements:

1. Section 01500 "Temporary Facilities and Controls" for temporary erosion- and sedimentation-control measures.

1.3 DEFINITIONS

A. Subsoil: Soil beneath the level of subgrade; soil beneath the topsoil layers of a naturally occurring soil profile, typified by less than 1 percent organic matter and few soil organisms.

B. Surface Soil: Soil that is present at the top layer of the existing soil profile. In undisturbed areas, surface soil is typically called "topsoil," but in disturbed areas such as urban environments, the surface soil can be subsoil.

C. Topsoil: Top layer of the soil profile consisting of existing native surface topsoil or existing in-place surface soil; the zone where plant roots grow.

D. Plant-Protection Zone: Area surrounding individual trees, groups of trees, shrubs, or other vegetation to be protected during construction and indicated on Drawings.

E. Tree-Protection Zone: Area surrounding individual trees or groups of trees to be protected during construction and indicated on Drawings.

F. Vegetation: Trees, shrubs, groundcovers, grass, and other plants.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.5 MATERIAL OWNERSHIP

A. Except for materials indicated to be stockpiled or otherwise remain Owner's property, cleared materials shall become Contractor's property and shall be removed from Project site.

1.6 INFORMATIONAL SUBMITTALS

A. Existing Conditions: Documentation of existing trees and plantings, adjoining construction, and site improvements that establishes preconstruction conditions that might be misconstrued as damage caused by site clearing.

1. Use sufficiently detailed photographs or video recordings.
2. Include plans and notations to indicate specific wounds and damage conditions of each tree or other plant designated to remain.

B. Topsoil stripping and stockpiling program.

C. Record Drawings: Identifying and accurately showing locations of capped utilities and other subsurface structural, electrical, and mechanical conditions.

1.7 QUALITY ASSURANCE

A. Topsoil Stripping and Stockpiling Program: Prepare a written program to systematically demonstrate the ability of personnel to properly follow procedures and handle materials and equipment during the Work. Include dimensioned diagrams for placement and protection of stockpiles.

1.8 FIELD CONDITIONS

A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing operations.

1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
2. Provide alternate routes around closed or obstructed trafficways if required by Owner or authorities having jurisdiction.

B. Improvements on Adjoining Property: Authority for performing site clearing indicated on property adjoining Owner's property will be obtained by Owner before award of Contract.

1. Do not proceed with work on adjoining property until directed by Architect.

C. Salvageable Improvements: Carefully remove items indicated to be salvaged and store on Owner's premises.

D. Utility Locator Service: Notify utility locator service for area where Project is located before site clearing.

E. Do not commence site clearing operations until temporary erosion- and sedimentation-control and plant-protection measures are in place.

F. Tree- and Plant-Protection Zones: Protect according to requirements in Section 015639 "Temporary Tree and Plant Protection."

G. Soil Stripping, Handling, and Stockpiling: Perform only when the soil is dry or slightly moist.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Satisfactory Soil Material: Requirements for satisfactory soil material are specified in Section 312000 "Earth Moving."

1. Obtain approved borrow soil material off-site when satisfactory soil material is not available on-site.

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect and maintain benchmarks and survey control points from disturbance during construction.

B. Verify that trees, shrubs, and other vegetation to remain or to be relocated have been flagged and that protection zones have been identified and enclosed according to requirements in Section 015639 "Temporary Tree and Plant Protection."

C. Protect existing site improvements to remain from damage during construction.

1. Restore damaged improvements to their original condition, as acceptable to Owner.

3.2 TEMPORARY EROSION AND SEDIMENTATION CONTROL

A. Provide temporary erosion- and sedimentation-control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to erosion- and sedimentation-control Drawings and requirements of authorities having jurisdiction.

B. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross protection zones.

C. Inspect, maintain, and repair erosion- and sedimentation-control measures during construction until permanent vegetation has been established.

D. Remove erosion and sedimentation controls, and restore and stabilize areas disturbed during removal.

3.3 TREE AND PLANT PROTECTION

A. Protect trees and plants remaining on-site according to requirements in Section 015639 "Temporary Tree and Plant Protection."

B. Repair or replace trees, shrubs, and other vegetation indicated to remain or be relocated that are damaged by construction operations according to requirements in Section 015639 "Temporary Tree and Plant Protection."

3.4 EXISTING UTILITIES

A. Owner will arrange for disconnecting and sealing indicated utilities that serve existing structures before site clearing, when requested by Contractor.

1. Verify that utilities have been disconnected and capped before proceeding with site clearing.

B. Locate, identify, disconnect, and seal or cap utilities indicated to be removed.

1. Arrange with utility companies to shut off indicated utilities.

C. Interrupting Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others, unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:

1. Notify Architect not less than seven days in advance of proposed utility interruptions.
2. Do not proceed with utility interruptions without Architect's written permission.

3.5 CLEARING AND GRUBBING

A. Remove obstructions, trees, shrubs, and other vegetation to permit installation of new construction.

1. Do not remove trees, shrubs, and other vegetation indicated to remain or to be relocated.
2. Grind down stumps and remove roots larger than 2 inches in diameter, obstructions, and debris to a depth of 18 inches below exposed subgrade.
3. Use only hand methods or air spade for grubbing within protection zones.
4. Chip removed tree branches and dispose of off-site.

B. Fill depressions caused by clearing and grubbing operations with satisfactory soil material unless further excavation or earthwork is indicated.

1. Place fill material in horizontal layers not exceeding a loose depth of 8 inches, and compact each layer to a density equal to adjacent original ground.

3.6 TOPSOIL STRIPPING

A. Remove sod and grass before stripping topsoil.

B. Strip topsoil to depth of 6 inches in a manner to prevent intermingling with underlying subsoil or other waste materials.

1. Remove subsoil and nonsoil materials from topsoil, including clay lumps, gravel, and other objects larger than 2 inches in diameter; trash, debris, weeds, roots, and other waste materials.

C. Stockpile topsoil away from edge of excavations without intermixing with subsoil or other materials. Grade and shape stockpiles to drain surface water. Cover to prevent windblown dust and erosion by water.

1. Limit height of topsoil stockpiles to 72 inches.
2. Do not stockpile topsoil within protection zones.
3. Dispose of surplus topsoil. Surplus topsoil is that which exceeds quantity indicated to be stockpiled or reused.

3.7 STOCKPILING ROCK

A. Remove from construction area naturally formed rocks that measure more than 1 foot across in least dimension. Do not include excavated or crushed rock.

B. Stockpile rock away from edge of excavations without intermixing with other materials. Cover to prevent windblown debris from accumulating among rocks.

1. Limit height of rock stockpiles to 36 inches.
2. Do not stockpile rock within protection zones.
3. Dispose of surplus rock. Surplus rock is that which exceeds quantity indicated to be stockpiled or reused.

3.8 SITE IMPROVEMENTS

A. Remove existing above- and below-grade improvements as indicated and necessary to facilitate new construction.

B. Remove slabs, paving, curbs, gutters, and aggregate base as indicated.

1. Unless existing full-depth joints coincide with line of demolition, neatly saw-cut along line of existing pavement to remain before removing adjacent existing pavement. Saw-cut faces vertically.
2. Paint cut ends of steel reinforcement in concrete to remain with two coats of antirust coating, following coating manufacturer's written instructions. Keep paint off surfaces that will remain exposed.

3.9 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Remove surplus soil material, unsuitable topsoil, obstructions, demolished materials, and waste materials including trash and debris, and legally dispose of them off Owner's property.

B. Burning tree, shrub, and other vegetation waste is permitted according to burning requirements and permitting of authorities having jurisdiction. Control such burning to produce the least smoke or air pollutants and minimum annoyance to surrounding properties. Burning of other waste and debris is prohibited.

C. Separate recyclable materials produced during site clearing from other nonrecyclable materials. Store or stockpile without intermixing with other materials, and transport them to recycling facilities. Do not interfere with other Project work.

END OF SECTION

SECTION 31 20 00 - EARTH MOVING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Excavating and filling for rough grading the Site.
2. Preparing subgrades for walks, pavements, turf and grasses, and plants.
3. Excavating and backfilling for buildings and structures.
4. Drainage course for concrete slabs-on-grade.
5. Subbase course for concrete walks and pavements.
6. Subbase course and base course for asphalt paving.
7. Subsurface drainage backfill for walls and trenches.
8. Excavating and backfilling trenches for utilities and pits for buried utility structures.
9. Excavating well hole to accommodate elevator-cylinder assembly.

B. Related Requirements:

1. Section 013200 "Construction Progress Documentation" for recording pre-excavation and earth-moving progress.
2. Section 311000 "Site Clearing" for site stripping, grubbing, stripping and stockpiling topsoil, and removal of above- and below-grade improvements and utilities.
3. Section 329200 "Turf and Grasses" for finish grading in turf and grass areas, including preparing and placing planting soil for turf areas.
4. Section 329300 "Plants" for finish grading in planting areas and tree and shrub pit excavation and planting.

1.2 UNIT PRICES

A. Work of this Section is affected by unit prices for earth moving specified in Section 012200 "Unit Prices."

B. Quantity allowances for earth moving are included in Section 012100 "Allowances."

C. Rock Measurement: Volume of rock actually removed, measured in original position, but not to exceed the following. Unit prices for rock excavation include replacement with approved materials.

1. 24 inches outside of concrete forms other than at footings.
2. 12 inches outside of concrete forms at footings.
3. 6 inches outside of minimum required dimensions of concrete cast against grade.
4. Outside dimensions of concrete walls indicated to be cast against rock without forms or exterior waterproofing treatments.
5. 6 inches beneath bottom of concrete slabs-on-grade.
6. 6 inches beneath pipe in trenches, and the greater of 24 inches wider than pipe or 42 inches wide.

1.3 DEFINITIONS

A. Backfill: Soil material or controlled low-strength material used to fill an excavation.

1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
2. Final Backfill: Backfill placed over initial backfill to fill a trench.

B. Base Course: Aggregate layer placed between the subbase course and hot-mix asphalt paving.

C. Bedding Course: Aggregate layer placed over the excavated subgrade in a trench before laying pipe.

D. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill.

E. Drainage Course: Aggregate layer supporting the slab-on-grade that also minimizes upward capillary flow of pore water.

F. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated.

1. Authorized Additional Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions as directed by Architect. Authorized additional excavation and replacement material will be paid for according to Contract provisions for unit prices.
2. Bulk Excavation: Excavation more than 10 feet in width and more than 30 feet in length.
3. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions without direction by Architect. Unauthorized excavation, as well as remedial work directed by Architect, will be without additional compensation.

G. Fill: Soil materials used to raise existing grades.

H. Rock:

1. Rock material in beds, ledges, unstratified masses, conglomerate deposits, and boulders of rock material 3/4 cu. yd or more in volume that exceed a standard penetration resistance of 100 blows/2 inches when tested by a geotechnical testing agency, according to ASTM D1586.

I. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other fabricated stationary features constructed above or below the ground surface.

J. Subbase Course: Aggregate layer placed between the subgrade and base course for hot-mix asphalt pavement, or aggregate layer placed between the subgrade and a cement concrete pavement or a cement concrete or hot-mix asphalt walk.

K. Subgrade: Uppermost surface of an excavation or the top surface of a fill or backfill immediately below subbase, drainage fill, drainage course, or topsoil materials.

L. Utilities: On-site underground pipes, conduits, ducts, and cables as well as underground services within buildings.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct pre-excavation conference at Project site.

1. Review methods and procedures related to earthmoving, including, but not limited to, the following:

a. Personnel and equipment needed to make progress and avoid delays.
b. Coordination of Work with utility locator service.
c. Coordination of Work and equipment movement with the locations of tree- and plant-protection zones.
d. Extent of trenching by hand or with air spade.
e. Field quality control.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of the following manufactured products required:

1. Geotextiles.
2. Warning tapes.

B. Samples for Verification: For the following products, in sizes indicated below:

1. Geotextile: 12 by 12 inches.
2. Warning Tape: 12 inches long; of each color.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified testing agency.

B. Material Test Reports: For each on-site and borrow soil material proposed for fill and backfill as follows:

1. Classification according to ASTM D2487.
2. Laboratory compaction curve according to ASTM D698.

C. Pre-excavation Photographs or Videotape: Show existing conditions of adjoining construction and site improvements, including finish surfaces that might be misconstrued as damage caused by earth-moving operations. Submit before earth moving begins.

1.7 QUALITY ASSURANCE

A. Geotechnical Testing Agency Qualifications: Qualified according to ASTM E329 and ASTM D3740 for testing indicated.

1.8 FIELD CONDITIONS

A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during earth-moving operations.

1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
2. Provide alternate routes around closed or obstructed traffic ways if required by Owner or authorities having jurisdiction.

B. Improvements on Adjoining Property: Authority for performing earth moving indicated on property adjoining Owner's property will be obtained by Owner before award of Contract.

1. Do not proceed with work on adjoining property until directed by Architect.

C. Utility Locator Service: Notify "Miss Utility" for area where Project is located before beginning earth-moving operations.

D. Do not commence earth-moving operations until temporary site fencing and erosion- and sedimentation-control measures specified in Section 015000 "Temporary Facilities and Controls" and Section 311000 "Site Clearing" are in place.

E. Do not commence earth-moving operations until plant-protection measures specified in Section 015639 "Temporary Tree and Plant Protection" are in place.

F. The following practices are prohibited within protection zones:

1. Storage of construction materials, debris, or excavated material.
2. Parking vehicles or equipment.
3. Foot traffic.
4. Erection of sheds or structures.
5. Impoundment of water.
6. Excavation or other digging unless otherwise indicated.
7. Attachment of signs to or wrapping materials around trees or plants unless otherwise indicated.

G. Do not direct vehicle or equipment exhaust towards protection zones.

H. Prohibit heat sources, flames, ignition sources, and smoking within or near protection zones.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.

B. Satisfactory Soils: Soil Classification Groups GW, GP, GM, SW, SP, and SM according to ASTM D2487, or a combination of these groups; free of rock or gravel larger than 3 inches in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter.

1. Liquid Limit: 30.
2. Plasticity Index: 15.

C. Unsatisfactory Soils: Soil Classification Groups GC, SC, CL, ML, OL, CH, MH, OH, and PT according to ASTM D2487, or a combination of these groups.

1. Unsatisfactory soils also include satisfactory soils not maintained within 2 percent of optimum moisture content at time of compaction.

D. Subbase Material: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D2940/D2940M; with at least 90 percent passing a 1-1/2-inch sieve and not more than 12 percent passing a No. 200 sieve.

E. Base Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D2940/D2940M; with at least 95 percent passing a 1-1/2-inch sieve and not more than 8 percent passing a No. 200 sieve.

F. Engineered Fill: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D2940/D2940M; with at least 90 percent passing a 1-1/2-inch sieve and not more than 12 percent passing a No. 200 sieve.

G. Bedding Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D2940/D2940M; except with 100 percent passing a 1-inch sieve and not more than 8 percent passing a No. 200 sieve.

H. Drainage Course: Narrowly graded mixture of washed, crushed stone, or crushed or uncrushed gravel; ASTM D448; coarse-aggregate grading Size 57; with 100 percent passing a 1-1/2-inch sieve and zero to 5 percent passing a No. 8 sieve.

I. Filter Material: Narrowly graded mixture of natural or crushed gravel, or crushed stone and natural sand; ASTM D448; coarse-aggregate grading Size 67; with 100 percent passing a 1-inch sieve and zero to 5 percent passing a No. 4 sieve.

J. Sand: ASTM C33/C33M; fine aggregate.

K. Impervious Fill: Clayey gravel and sand mixture capable of compacting to a dense state.

2.2 GEOTEXTILES

A. Subsurface Drainage Geotextile: Nonwoven needle-punched geotextile, manufactured for subsurface drainage applications, made from polyolefins or polyesters; with elongation greater than 50 percent; complying with AASHTO M 288 and the following, measured per test methods referenced:

1. Survivability:

a. Class 2; AASHTO M 288.
b. As follows:

1) Grab Tensile Strength: 200 lbf; ASTM D4632.
2) Tear Strength: 80 lbf; ASTM D4533.
3) Puncture Strength: 450 lbf; ASTM D4833.

c. Apparent Opening Size: No. 70 sieve, maximum; ASTM D4751.
d. Permittivity: 1.1] per second, minimum; ASTM D4491.
e. UV Stability: 70 percent after 500 hours' exposure; ASTM D4355.

B. Separation Geotextile: Woven geotextile fabric, manufactured for separation applications, made from polyolefins or polyesters; with elongation less than 50 percent; complying with AASHTO M 288 and the following, measured per test methods referenced:

1. Survivability:

    a. Class 2; AASHTO M 288.
    b. As follows:

        1) Grab Tensile Strength: 200 lbf; ASTM D4632.
        2) Tear Strength: 75 lbf; ASTM D4533.
        3) Puncture Strength: 450 lbf; ASTM D4833.

    c. Apparent Opening Size: No. 30 sieve, maximum; ASTM D4751.
    d. Permittivity: 0.05 per second, minimum; ASTM D4491.
    e. UV Stability: 70 percent after 500 hours' exposure; ASTM D4355.

2.3 ACCESSORIES

A. Warning Tape: Acid- and alkali-resistant, polyethylene film warning tape manufactured for marking and identifying underground utilities, 6 inches wide and 4 mils thick, continuously inscribed with a description of the utility; colored as follows:

1. Red: Electric.
2. Yellow: Gas, oil, steam, and dangerous materials.
3. Orange: Telephone and other communications.
4. Blue: Water systems.
5. Green: Sewer systems.

B. Detectable Warning Tape: Acid- and alkali-resistant, polyethylene film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches wide and 4 mils thick, continuously inscribed with a description of the utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches deep; colored as follows:

1. Red: Electric.
2. Yellow: Gas, oil, steam, and dangerous materials.
3. Orange: Telephone and other communications.
4. Blue: Water systems.
5. Green: Sewer systems.

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earth-moving operations.

B. Protect and maintain erosion and sedimentation controls during earth-moving operations.

C. Protect subgrades and foundation soils from freezing temperatures and frost. Remove temporary protection before placing subsequent materials.

3.2 DEWATERING

A. Provide dewatering system of sufficient scope, size, and capacity to control hydrostatic pressures and to lower, control, remove, and dispose of ground water and permit excavation and construction to proceed on dry, stable subgrades.

B. Prevent surface water and ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area.

C. Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation.

1. Reroute surface water runoff away from excavated areas. Do not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches.

D. Dispose of water removed by dewatering in a manner that avoids endangering public health, property, and portions of work under construction or completed. Dispose of water and sediment in a manner that avoids inconvenience to others.

3.3 EXPLOSIVES

A. Explosives:

1. Do not use explosives.

3.4 EXCAVATION, GENERAL

A. Unclassified Excavation: Excavate to subgrade elevations regardless of the character of surface and subsurface conditions encountered. Unclassified excavated materials may include rock, soil materials, and obstructions. No changes in the Contract Sum or the Contract Time will be authorized for rock excavation or removal of obstructions.

1. If excavated materials intended for fill and backfill include unsatisfactory soil materials and rock, replace with satisfactory soil materials.
2. Remove rock to lines and grades indicated to permit installation of permanent construction without exceeding the following dimensions:

a. 24 inches outside of concrete forms other than at footings.
b. 12 inches outside of concrete forms at footings.
c. 6 inches outside of minimum required dimensions of concrete cast against grade.
d. Outside dimensions of concrete walls indicated to be cast against rock without forms or exterior waterproofing treatments.
e. 6 inches beneath bottom of concrete slabs-on-grade.
f. 6 inches beneath pipe in trenches and the greater of 24 inches wider than pipe or 42 inches wide.

B. Classified Excavation: Excavate to subgrade elevations. Material to be excavated will be classified as earth and rock. Do not excavate rock until it has been classified and cross sectioned by Architect. The Contract Sum will be adjusted for rock excavation according to unit prices included in the Contract Documents. Changes in the Contract Time may be authorized for rock excavation.

1. Earth excavation includes excavating pavements and obstructions visible on surface; underground structures, utilities, and other items indicated to be removed; and soil, boulders, and other materials not classified as rock or unauthorized excavation.

    a. Intermittent drilling; blasting, if permitted; ram hammering; or ripping of material not classified as rock excavation is earth excavation.

2. Rock excavation includes removal and disposal of rock. Remove rock to lines and subgrade elevations indicated to permit installation of permanent construction without exceeding the following dimensions:

    a. 24 inches outside of concrete forms other than at footings.
    b. 12 inches outside of concrete forms at footings.
    c. 6 inches outside of minimum required dimensions of concrete cast against grade.
    d. Outside dimensions of concrete walls indicated to be cast against rock without forms or exterior waterproofing treatments.
    e. 6 inches beneath bottom of concrete slabs-on-grade.
    f. 6 inches beneath pipe in trenches and the greater of 24 inches wider than pipe or 42 inches wide.

3.5 EXCAVATION FOR STRUCTURES

A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 1 inch. If applicable, extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, and for inspections.

1. Excavations for Footings and Foundations: Do not disturb bottom of excavation. Excavate by hand to final grade just before placing concrete reinforcement. Trim bottoms to required lines and grades to leave solid base to receive other work.

B. Excavations at Edges of Tree- and Plant-Protection Zones:

1. Excavate by hand or with an air spade to indicated lines, cross sections, elevations, and subgrades. If excavating by hand, use narrow-tine spading forks to comb soil and expose roots. Do not break, tear, or chop exposed roots. Do not use mechanical equipment that rips, tears, or pulls roots.
2. Cut and protect roots according to requirements in Section 015639 "Temporary Tree and Plant Protection."

3.6 EXCAVATION FOR WALKS AND PAVEMENTS

A. Excavate surfaces under walks and pavements to indicated lines, cross sections, elevations, and subgrades.

3.7 EXCAVATION FOR UTILITY TRENCHES

A. Excavate trenches to indicated gradients, lines, depths, and elevations.

1. Beyond building perimeter, excavate trenches to allow installation of top of pipe below frost line.

B. Excavate trenches to uniform widths to provide the following clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to 12 inches higher than top of pipe or conduit unless otherwise indicated.

1. Clearance: 12 inches each side of pipe or conduit.

C. Trench Bottoms:

1. Excavate trenches 4 inches deeper than bottom of pipe and conduit elevations to allow for bedding course. Hand-excavate deeper for bells of pipe.

a. Excavate trenches 6 inches deeper than elevation required in rock or other unyielding bearing material to allow for bedding course.

D. Trenches in Tree- and Plant-Protection Zones:

1. Hand-excavate to indicated lines, cross sections, elevations, and subgrades. Use narrow-tine spading forks to comb soil and expose roots. Do not break, tear, or chop exposed roots. Do not use mechanical equipment that rips, tears, or pulls roots.
2. Do not cut main lateral roots or taproots; cut only smaller roots that interfere with installation of utilities.
3. Cut and protect roots according to requirements in Section 015639 "Temporary Tree and Plant Protection."

3.8 EXCAVATION FOR ELEVATOR CYLINDER

A. Drill well hole plumb in elevator pit to accommodate installation of elevator-cylinder assembly. Coordinate with applicable requirements for diameter and tolerances in Section 142400 "Hydraulic Elevators."

B. Provide well casing as necessary to retain walls of well hole.

3.9 SUBGRADE INSPECTION

A. Notify Architect when excavations have reached required subgrade.

B. If Architect determines that unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed.

C. Proof-roll subgrade below the building slabs and pavements with a pneumatic-tired and loaded 10-wheel, tandem-axle dump truck weighing not less than 15 tons to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.

1. Completely proof-roll subgrade in one direction, repeating proof-rolling in direction perpendicular to first direction. Limit vehicle speed to 3 mph.
2. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Architect, and replace with compacted backfill or fill as directed.

D. Authorized additional excavation and replacement material will be paid for according to Contract provisions for unit prices.

E. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Architect, without additional compensation.

3.10 UNAUTHORIZED EXCAVATION

A. Fill unauthorized excavation under foundations or wall footings by extending bottom elevation of concrete foundation or footing to excavation bottom, without altering top elevation. Lean concrete fill, with 28-day compressive strength of 2500 psi, may be used when approved by Architect.

1. Fill unauthorized excavations under other construction, pipe, or conduit as directed by Architect.

3.11 STORAGE OF SOIL MATERIALS

A. Stockpile borrow soil materials and excavated satisfactory soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.

1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

3.12 BACKFILL

A. Place and compact backfill in excavations promptly, but not before completing the following:

1. Construction below finish grade including, where applicable, subdrainage, dampproofing, waterproofing, and perimeter insulation.
2. Surveying locations of underground utilities for Record Documents.
3. Testing and inspecting underground utilities.
4. Removing concrete formwork.
5. Removing trash and debris.
6. Removing temporary shoring, bracing, and sheeting.
7. Installing permanent or temporary horizontal bracing on horizontally supported walls.

B. Place backfill on subgrades free of mud, frost, snow, or ice.

3.13 UTILITY TRENCH BACKFILL

A. Place backfill on subgrades free of mud, frost, snow, or ice.

B. Place and compact bedding course on trench bottoms and where indicated. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.

C. Trenches under Footings: Backfill trenches excavated under footings and within 18 inches of bottom of footings with satisfactory soil; fill with concrete to elevation of bottom of footings. Concrete is specified in Section 033000 "Cast-in-Place Concrete."

D. Trenches under Roadways: Provide 4-inch-thick, concrete-base slab support for piping or conduit less than 30 inches below surface of roadways. After installing and testing, completely encase piping or conduit in a minimum of 4 inches of concrete before backfilling or placing roadway subbase course. Concrete is specified in Section 033000 "Cast-in-Place Concrete."

E. Backfill voids with satisfactory soil while removing shoring and bracing.

F. Initial Backfill:

1. Soil Backfill: Place and compact initial backfill of satisfactory soil, free of particles larger than 1 inch in any dimension, to a height of 12 inches over the pipe or conduit.

a. Carefully compact initial backfill under pipe haunches and compact evenly up on both sides and along the full length of piping or conduit to avoid damage or displacement of piping or conduit. Coordinate backfilling with utilities testing.

G. Final Backfill:

1. Soil Backfill: Place and compact final backfill of satisfactory soil to final subgrade elevation.

H. Warning Tape: Install warning tape directly above utilities, 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs.

3.14 SOIL FILL

A. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing material.

B. Place and compact fill material in layers to required elevations as follows:

1. Under grass and planted areas, use satisfactory soil material.
2. Under walks and pavements, use satisfactory soil material.
3. Under steps and ramps, use engineered fill.
4. Under building slabs, use engineered fill.
5. Under footings and foundations, use engineered fill.

C. Place soil fill on subgrades free of mud, frost, snow, or ice.

3.15 SOIL MOISTURE CONTROL

A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compaction to within 2 percent of optimum moisture content.

1. Do not place backfill or fill soil material on surfaces that are muddy, frozen, or contain frost or ice.
2. Remove and replace, or scarify and air dry, otherwise satisfactory soil material that exceeds optimum moisture content by 2 percent and is too wet to compact to specified dry unit weight.

3.16 COMPACTION OF SOIL BACKFILLS AND FILLS

A. Place backfill and fill soil materials in layers not more than 8 inches in loose depth for material compacted by heavy compaction equipment and not more than 4 inches in loose depth for material compacted by hand-operated tampers.

B. Place backfill and fill soil materials evenly on all sides of structures to required elevations and uniformly along the full length of each structure.

C. Compact soil materials to not less than the following percentages of maximum dry unit weight according to ASTM D698:

1. Under structures, building slabs, steps, and pavements, scarify and recompact top 12 inches of existing subgrade and each layer of backfill or fill soil material at 95 percent.
2. Under walkways, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill soil material at 92 percent.
3. Under turf or unpaved areas, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill soil material at 85 percent.
4. For utility trenches, compact each layer of initial and final backfill soil material at 85 percent.

3.17 GRADING

A. General: Uniformly grade areas to a smooth surface, free of irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.

1. Provide a smooth transition between adjacent existing grades and new grades.
2. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.

B. Site Rough Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to elevations required to achieve indicated finish elevations, within the following subgrade tolerances:

1. Turf or Unpaved Areas: Plus or minus 1 inch.
2. Walks: Plus or minus 1 inch.
3. Pavements: Plus or minus 1/2 inch.

C. Grading inside Building Lines: Finish subgrade to a tolerance of 1/2 inch when tested with a 10-foot straightedge.

3.18 SUBSURFACE DRAINAGE

.

A. Subsurface Drain: Place subsurface drainage geotextile around perimeter of subdrainage trench. Place a 6-inch course of filter material on subsurface drainage geotextile to support subdrainage pipe. Encase subdrainage pipe in a minimum of 12 inches of filter material, placed in compacted layers 6 inches thick, and wrap in subsurface drainage geotextile, overlapping sides and ends at least 6 inches.

1. Compact each filter material layer with a minimum of two passes of a plate-type vibratory compactor.

B. Drainage Backfill: Place and compact filter material over subsurface drain, in width indicated, to within 12 inches of final subgrade, in compacted layers 6 inches thick. Overlay drainage backfill with one layer of subsurface drainage geotextile, overlapping sides and ends at least 6 inches.

1. Compact each filter material layer with a minimum of two passes of a plate-type vibratory compactor.
2. Place and compact impervious fill over drainage backfill in 6-inch- thick compacted layers to final subgrade.

3.19 SUBBASE AND BASE COURSES UNDER PAVEMENTS AND WALKS

A. Place subbase course and base course on subgrades free of mud, frost, snow, or ice.

B. On prepared subgrade, place subbase course and base course under pavements and walks as follows:

1. Install separation geotextile on prepared subgrade according to manufacturer's written instructions, overlapping sides and ends.
2. Place base course material over subbase course under hot-mix asphalt pavement.
3. Shape subbase course and base course to required crown elevations and cross-slope grades.
4. Place subbase course and base course 6 inches or less in compacted thickness in a single layer.
5. Place subbase course and base course that exceeds 6 inches in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches thick or less than 3 inches thick.
6. Compact subbase course and base course at optimum moisture content to required grades, lines, cross sections, and thickness to not less than 95 percent of maximum dry unit weight according to ASTM D698.

3.20 DRAINAGE COURSE UNDER CONCRETE SLABS-ON-GRADE

A. Place drainage course on subgrades free of mud, frost, snow, or ice.

B. On prepared subgrade, place and compact drainage course under cast-in-place concrete slabs-on-grade as follows:

1. Install subdrainage geotextile on prepared subgrade according to manufacturer's written instructions, overlapping sides and ends.
2. Place drainage course 6 inches or less in compacted thickness in a single layer.
3. Place drainage course that exceeds 6 inches in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches thick or less than 3 inches thick.
4. Compact each layer of drainage course to required cross sections and thicknesses to not less than 95 percent of maximum dry unit weight according to ASTM D698.

3.21 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified geotechnical engineering testing agency to perform tests and inspections.

B. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earth moving only after test results for previously completed work comply with requirements.

C. Footing Subgrade: At footing subgrades, at least one test of each soil stratum will be performed to verify design bearing capacities. Subsequent verification and approval of other footing subgrades may be based on a visual comparison of subgrade with tested subgrade when approved by Architect.

D. Testing agency will test compaction of soils in place according to ASTM D1556, ASTM D2167, ASTM D2937, and ASTM D6938, as applicable. Tests will be performed at the following locations and frequencies:

1. Paved and Building Slab Areas: At subgrade and at each compacted fill and backfill layer, at least one test for every 2000 sq. ft. or less of paved area or building slab but in no case fewer than three tests.
2. Foundation Wall Backfill: At each compacted backfill layer, at least one test for every 100 feet or less of wall length but no fewer than two tests.
3. Trench Backfill: At each compacted initial and final backfill layer, at least one test for every 150 feet or less of trench length but no fewer than two tests.

E. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil materials to depth required; recompact and retest until specified compaction is obtained.

3.22 PROTECTION

A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.

B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.

1. Scarify or remove and replace soil material to depth as directed by Architect; reshape and recompact.

C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.

1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

3.23 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Remove surplus satisfactory soil and waste materials, including unsatisfactory soil, trash, and debris, and legally dispose of them off Owner's property.

END OF SECTION

SECTION 32 12 16 - ASPHALT PAVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Hot-mix asphalt paving.
2. Hot-mix asphalt overlay.
3. Cold milling of existing asphalt pavement.
4. Hot-mix asphalt patching.

B. Related Requirements:

1. Section 024116 "Structure Demolition" for demolition and removal of existing asphalt pavement.
2. Section 312000 "Earth Moving" for subgrade preparation, fill material, separation geotextiles, unbound-aggregate subbase and base courses, and aggregate pavement shoulders.
3. Section 321313 "Concrete Paving" for concrete pavement and for separate concrete curbs, gutters, and driveway aprons.
4. Section 321373 "Concrete Paving Joint Sealants" for joint sealants and fillers at pavement terminations.
5. Section 321400 "Unit Paving" for bituminous setting bed for pavers and for stone and precast concrete curbs.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review methods and procedures related to hot-mix asphalt paving including, but not limited to, the following:

a. Review proposed sources of paving materials, including capabilities and location of plant that will manufacture hot-mix asphalt.
b. Review requirements for protecting paving work, including restriction of traffic during installation period and for remainder of construction period.

1.4 ACTION SUBMITTALS

A. Product Data: Include technical data and tested physical and performance properties.

1. Herbicide.

2. Paving geotextile.
3. Joint sealant.

B. Hot-Mix Asphalt Designs:

1. Certification, by authorities having jurisdiction, of approval of each hot-mix asphalt design proposed for the Work.
2. For each hot-mix asphalt design proposed for the Work.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For paving-mix manufacturer and testing agency.

B. Material Certificates:

1. Aggregates.
2. Asphalt binder.
3. Asphalt cement.

C. Field quality-control reports.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: A paving-mix manufacturer registered with and approved by the Maryland State Highway Administration.

B. Testing Agency Qualifications: Qualified in accordance with ASTM D3666 for testing indicated.

C. Regulatory Requirements: Comply with materials, workmanship, and other applicable requirements of AASHTO and the Standards and Specifications of the Maryland State Highway Administration for asphalt paving work.

1. Measurement and payment provisions and safety program submittals included in standard specifications do not apply to this Section.

1.7 FIELD CONDITIONS

A. Environmental Limitations: Do not apply asphalt materials if subgrade is wet or excessively damp, if rain is imminent or expected before time required for adequate cure, or if the following conditions are not met:

1. Prime Coat: Minimum surface temperature of 60 deg F.
2. Asphalt Base Course: Minimum surface temperature of 40 deg F and rising at time of placement.
3. Asphalt Surface Course: Minimum surface temperature of 60 deg F at time of placement.

PART 2 - PRODUCTS

2.1 AGGREGATES

A. General: Use materials and gradations that have performed satisfactorily in previous installations.

B. Coarse Aggregate: ASTM D692/D692M, sound; angular crushed stone, crushed gravel, or cured, crushed blast-furnace slag.

C. Fine Aggregate: ASTM D1073, sharp-edged natural sand or sand prepared from stone, gravel, cured blast-furnace slag, or combinations thereof.

1. For hot-mix asphalt, limit natural sand to a maximum of 20 percent by weight of the total aggregate mass.

2.2 ASPHALT MATERIALS

A. Asphalt Binder: AASHTO M 320 binder designation PG 64-22.

B. Asphalt Cement: In accordance with Maryland State Highway Administration standards and specifications.

C. Tack Coat: In accordance with Maryland State Highway Administration standards and specifications.

D. Water: Potable.

E. Undersealing Asphalt: ASTM D3141/D3141M; pumping consistency.

2.3 AUXILIARY MATERIALS

A. Herbicide: Commercial chemical for weed control, registered by the EPA, and not classified as "restricted use" for locations and conditions of application. Provide in granular, liquid, or wettable powder form.

B. Joint Sealant: In accordance with Maryland State Highway Administration standards and specifications.

2.4 MIXES

A. Hot-Mix Asphalt: Dense-graded, hot-laid, hot-mix asphalt plant mixes approved by Maryland State Highway Administration Standards and Specifications and complying with the following requirements:

1. Provide mixes with a history of satisfactory performance in geographical area where Project is located.
2. Base Course: 19.0mm Superpave, PG-64S-22.
3. Surface Course: 9.5mm Superpave, PG-64S-22.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that subgrade is dry and in suitable condition to begin paving.

B. Proceed with paving only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Protection: Provide protective materials, procedures, and worker training to prevent asphalt materials from spilling, coating, or building up on curbs, driveway aprons, manholes, and other surfaces adjacent to the Work.

B. Proof-roll subgrade below pavements with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.

1. Completely proof-roll subgrade in one direction, repeating proof-rolling in direction perpendicular to first direction. Limit vehicle speed to 3 mph.
2. Proof-roll with a loaded 10-wheel, tandem-axle dump truck weighing not less than 15 tons.
3. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Architect, and replace with compacted backfill or fill as directed.

3.3 COLD MILLING

A. Clean existing pavement surface of loose and deleterious material immediately before cold milling. Remove existing asphalt pavement by cold milling to grades and cross sections indicated.

1. Mill to a depth of 2 inches.
2. Mill to a uniform finished surface free of excessive gouges, grooves, and ridges.
3. Control rate of milling to prevent tearing of existing asphalt course.
4. Repair or replace curbs, driveway aprons, manholes, and other construction damaged during cold milling.
5. Excavate and trim unbound-aggregate base course, if encountered, and keep material separate from milled hot-mix asphalt.
6. Patch surface depressions deeper than 1 inch after milling, before wearing course is laid.
7. Handle milled asphalt material in accordance with approved waste management plan required in Section 017419 "Construction Waste Management and Disposal."
8. Keep milled pavement surface free of loose material and dust.
9. Do not allow milled materials to accumulate on-site.

3.4 PATCHING

A. Asphalt Pavement: Saw cut perimeter of patch and excavate existing pavement section to sound base. Excavate rectangular or trapezoidal patches, extending 12 inches into perimeter of adjacent sound pavement, unless otherwise indicated. Cut excavation faces vertically. Remove excavated material. Recompact existing unbound-aggregate base course to form new subgrade.

B. Portland Cement Concrete Pavement: Break cracked slabs and roll as required to reseat concrete pieces firmly.

1. Undersealing: Pump hot undersealing asphalt under rocking slab until slab is stabilized or, if necessary, crack slab into pieces and roll to reseat pieces firmly.
2. Remove disintegrated or badly cracked pavement. Excavate rectangular or trapezoidal patches, extending into perimeter of adjacent sound pavement, unless otherwise indicated. Cut excavation faces vertically. Recompact existing unbound-aggregate base course to form new subgrade.

C. Tack Coat: Before placing patch material, apply tack coat uniformly to vertical asphalt surfaces abutting the patch. Apply at a rate of 0.05 to 0.15 gal./sq. yd..

1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.

D. Placing Single-Course Patch Material: Fill excavated pavement areas with hot-mix asphalt base mix for full thickness of patch and, while still hot, compact flush with adjacent surface.

E. Placing Two-Course Patch Material: Partially fill excavated pavements with hot-mix asphalt base course mix and, while still hot, compact. Cover asphalt base course with compacted layer of hot-mix asphalt surface course, finished flush with adjacent surfaces.

3.5 REPAIRS

A. Leveling Course: Install and compact leveling course consisting of hot-mix asphalt surface course to level sags and fill depressions deeper than 1 inch in existing pavements.

1. Install leveling wedges in compacted lifts not exceeding 3 inches thick.

B. Crack and Joint Filling: Remove existing joint filler material from cracks or joints to a depth of 1/4 inch.

1. Clean cracks and joints in existing hot-mix asphalt pavement.
2. Use emulsified-asphalt slurry to seal cracks and joints less than 1/4 inch wide. Fill flush with surface of existing pavement and remove excess.
3. Use hot-applied joint sealant to seal cracks and joints more than 1/4 inch wide. Fill flush with surface of existing pavement and remove excess.

3.6 SURFACE PREPARATION

A. Ensure that prepared subgrade has been proof-rolled and is ready to receive paving. Immediately before placing asphalt materials, remove loose and deleterious material from substrate surfaces.

B. Herbicide Treatment: Apply herbicide in accordance with manufacturer's recommended rates and written application instructions. Apply to dry, prepared subgrade or surface of compacted-aggregate base before applying paving materials.

1. Mix herbicide with prime coat if formulated by manufacturer for that purpose.

C. Tack Coat: Apply uniformly to surfaces of existing pavement at a rate of 0.05 to 0.15 gal./sq. yd..

1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.

3.7 HOT-MIX ASPHALT PLACEMENT

A. Machine place hot-mix asphalt on prepared surface, spread uniformly, and strike off. Place asphalt mix by hand in areas inaccessible to equipment in a manner that prevents segregation of mix. Place each course to required grade, cross section, and thickness when compacted.

1. Place hot-mix asphalt base course in number of lifts and thicknesses indicated.
2. Place hot-mix asphalt surface course in single lift.
3. Spread mix at a minimum temperature of 250 deg F.
4. Begin applying mix along centerline of crown for crowned sections and on high side of one-way slopes unless otherwise indicated.
5. Regulate paver machine speed to obtain smooth, continuous surface free of pulls and tears in asphalt-paving mat.

B. Place paving in consecutive strips not less than 10 feet wide unless infill edge strips of a lesser width are required.

1. After first strip has been placed and rolled, place succeeding strips and extend rolling to overlap previous strips. Overlap mix placement about 1 to 1-1/2 inches from strip to strip to ensure proper compaction of mix along longitudinal joints.
2. Complete a section of asphalt base course before placing asphalt surface course.

C. Promptly correct surface irregularities in paving course behind paver. Use suitable hand tools to remove excess material forming high spots. Fill depressions with hot-mix asphalt to prevent segregation of mix; use suitable hand tools to smooth surface.

3.8 JOINTS

A. Construct joints to ensure a continuous bond between adjoining paving sections. Construct joints free of depressions, with same texture and smoothness as other sections of hot-mix asphalt course.

1. Clean contact surfaces and apply tack coat to joints.
2. Offset longitudinal joints, in successive courses, a minimum of 6 inches.
3. Offset transverse joints, in successive courses, a minimum of 24 inches.
4. Compact joints as soon as hot-mix asphalt will bear roller weight without excessive displacement.
5. Compact asphalt at joints to a density within 2 percent of specified course density.

3.9 COMPACTION

A. General: Begin compaction as soon as placed hot-mix paving will bear roller weight without excessive displacement. Compact hot-mix paving with hot hand tampers or with vibratory-plate compactors in areas inaccessible to rollers.

1. Complete compaction before mix temperature cools to 185 deg F.

B. Breakdown Rolling: Complete breakdown or initial rolling immediately after rolling joints and outside edge. Examine surface immediately after breakdown rolling for indicated crown, grade, and smoothness. Correct laydown and rolling operations to comply with requirements.

C. Intermediate Rolling: Begin intermediate rolling immediately after breakdown rolling while hot-mix asphalt is still hot enough to achieve specified density. Continue rolling until hot-mix asphalt course has been uniformly compacted to the following density:

1. Average Density, Marshall Test Method: 96 percent of reference laboratory density in accordance with ASTM D6927, but not less than 94 percent or greater than 100 percent.
2. Average Density, Rice Test Method: 92 percent of reference maximum theoretical density in accordance with ASTM D2041/D2041M, but not less than 90 percent or greater than 96 percent.

D. Finish Rolling: Finish roll paved surfaces to remove roller marks while hot-mix asphalt is still warm.

E. Edge Shaping: While surface is being compacted and finished, trim edges of pavement to proper alignment. Bevel edges while asphalt is still hot; compact thoroughly.

F. Repairs: Remove paved areas that are defective or contaminated with foreign materials and replace with fresh, hot-mix asphalt. Compact by rolling to specified density and surface smoothness.

G. Protection: After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened.

H. Erect barricades to protect paving from traffic until mixture has cooled enough not to become marked.

3.10 INSTALLATION TOLERANCES

A. Pavement Thickness: Compact each course to produce thickness indicated within the following tolerances:

1. Base Course: Plus or minus 1/2 inch.
2. Surface Course: Plus 1/4 inch, no minus.

B. Pavement Surface Smoothness: Compact each course to produce surface smoothness within the following tolerances as determined by using a 10-foot straightedge applied transversely or longitudinally to paved areas:

1. Base Course: 1/4 inch.
2. Surface Course: 1/8 inch.

3.11 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Thickness: In-place compacted thickness of hot-mix asphalt courses will be determined in accordance with ASTM D3549/D3549M.

C. Surface Smoothness: Finished surface of each hot-mix asphalt course will be tested for compliance with smoothness tolerances.

D. In-Place Density: Testing agency will take samples of uncompacted paving mixtures and compacted pavement in accordance with ASTM D979/D979M.

1. Reference maximum theoretical density will be determined by averaging results from four samples of hot-mix asphalt-paving mixture delivered daily to site, prepared in accordance with ASTM D2041/D2041M, and compacted in accordance with job-mix specifications.
2. In-place density of compacted pavement will be determined by testing core samples in accordance with ASTM D1188 or ASTM D2726/D2726M.

a. One core sample will be taken for every 1000 sq. yd. or less of installed pavement, with no fewer than three cores taken.
b. Field density of in-place compacted pavement may also be determined by nuclear method in accordance with ASTM D2950/D2950M and coordinated with ASTM D1188 or ASTM D2726/D2726M.

E. Replace and compact hot-mix asphalt where core tests were taken.

F. Remove and replace or install additional hot-mix asphalt where test results or measurements indicate that it does not comply with specified requirements.

3.12 WASTE HANDLING

A. General: Handle asphalt-paving waste in accordance with approved waste management plan required in Section 017419 "Construction Waste Management and Disposal."

END OF SECTION

SECTION 32 13 13 - CONCRETE PAVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes Concrete Paving**.**

1. Driveways.
2. Curbs and gutters.
3. Walks.

B. Related Requirements:

1. Section 033000 "Cast-in-Place Concrete" for general building applications of concrete.
2. Section 321316 "Decorative Concrete Paving" for stamped concrete other than stamped detectable warnings.
3. Section 321373 "Concrete Paving Joint Sealants" for joint sealants in expansion and contraction joints within concrete paving and in joints between concrete paving and asphalt paving or adjacent construction.
4. Section 321723 "Pavement Markings."
5. Section 321726 "Tactile Warning Surfacing" for detectable warning mats.

1.3 DEFINITIONS

A. Cementitious Materials: Portland cement alone or in combination with one or more of blended hydraulic cement, fly ash, slag cement, and other pozzolans.

B. W/C Ratio: The ratio by weight of water to cementitious materials.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review methods and procedures related to concrete paving, including but not limited to, the following:

a. Concrete mixture design.
b. Quality control of concrete materials and concrete paving construction practices.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Design Mixtures: For each concrete paving mixture. Include alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified ready-mix concrete manufacturer and testing agency.

B. Material Certificates: For the following, from manufacturer:

1. Cementitious materials.
2. Steel reinforcement and reinforcement accessories.
3. Admixtures.
4. Curing compounds.
5. Bonding agent or epoxy adhesive.
6. Joint fillers.

C. Material Test Reports: For each of the following:

1. Aggregates: Include service-record data indicating absence of deleterious expansion of concrete due to alkali-aggregate reactivity.

D. Field quality-control reports.

1.7 QUALITY ASSURANCE

A. Ready-Mix-Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C94/C94M requirements for production facilities and equipment.

B. Testing Agency Qualifications: Qualified according to ASTM C1077 and ASTM E329 for testing indicated.

1. Personnel conducting field tests shall be qualified as ACI Concrete Field-Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.

1.8 PRECONSTRUCTION TESTING

A. Preconstruction Testing Service: Engage a qualified independent testing agency to perform preconstruction testing on concrete paving mixtures.

1.9 FIELD CONDITIONS

A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.

B. Cold-Weather Concrete Placement: Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing, or low temperatures. Comply with ACI 306.1 and the following:

1. When air temperature has fallen to or is expected to fall below 40 deg F, uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F and not more than 80 deg F at point of placement.
2. Do not use frozen materials or materials containing ice or snow.
3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in design mixtures.

C. Hot-Weather Concrete Placement: Comply with ACI 301 and as follows when hot-weather conditions exist:

1. Cool ingredients before mixing to maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated in total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
2. Cover steel reinforcement with water-soaked burlap, so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.
3. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

PART 2 - PRODUCTS

2.1 CONCRETE, GENERAL

A. ACI Publications: Comply with ACI 301 unless otherwise indicated.

2.2 FORMS

A. Form Materials: Plywood, metal, metal-framed plywood, or other approved panel-type materials to provide full-depth, continuous, straight, and smooth exposed surfaces.

1. Use flexible or uniformly curved forms for curves with a radius of 100 feet or less. Do not use notched and bent forms.

B. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and that will not impair subsequent treatments of concrete surfaces.

2.3 STEEL REINFORCEMENT

A. Plain-Steel Welded-Wire Reinforcement: ASTM A1064/A1064M, fabricated from galvanized-steel wire into flat sheets.

B. Deformed-Steel Welded-Wire Reinforcement: ASTM A1064/A1064M, flat sheet.

C. Epoxy-Coated Welded-Wire Reinforcement: ASTM A884/A884M, Class A, plain steel.

D. Reinforcing Bars: ASTM A615/A615M, Grade 60; deformed.

E. Epoxy-Coated Reinforcing Bars: ASTM A775/A775M or ASTM A934/A934M; with ASTM A615/A615M, Grade 60 deformed bars.

F. Steel Bar Mats: ASTM A184/A184M; with ASTM A615/A615M, Grade 60 deformed bars; assembled with clips.

G. Plain-Steel Wire: ASTM A1064/A1064M, galvanized.

H. Deformed-Steel Wire: ASTM A1064/A1064M.

I. Epoxy-Coated-Steel Wire: ASTM A884/A884M, Class A; coated, plain.

J. Joint Dowel Bars: ASTM A615/A615M, Grade 60 plain-steel bars; zinc coated (galvanized) after fabrication according to ASTM A767/A767M, Class I coating. Cut bars true to length with ends square and free of burrs.

K. Epoxy-Coated, Joint Dowel Bars: ASTM A775/A775M; with ASTM A615/A615M, Grade 60 plain-steel bars.

L. Tie Bars: ASTM A615/A615M, Grade 60; deformed.

M. Hook Bolts: ASTM A307, Grade A, internally and externally threaded. Design hook-bolt joint assembly to hold coupling against paving form and in position during concreting operations, and to permit removal without damage to concrete or hook bolt.

N. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars, welded-wire reinforcement, and dowels in place. Manufacture bar supports according to CRSI's "Manual of Standard Practice" from steel wire, plastic, or precast concrete of greater compressive strength than concrete specified, and as follows:

1. Equip wire bar supports with sand plates or horizontal runners where base material will not support chair legs.
2. For epoxy-coated reinforcement, use epoxy-coated or other dielectric-polymer-coated wire bar supports.

O. Epoxy Repair Coating: Liquid, two-part, epoxy repair coating, compatible with epoxy coating on reinforcement.

P. Zinc Repair Material: ASTM A780/A780M.

2.4 CONCRETE MATERIALS

A. Cementitious Materials: Use the following cementitious materials, of same type, brand, and source throughout Project:

1. Portland Cement: ASTM C150/C150M, white portland cement Type II.

B. Normal-Weight Aggregates: ASTM C33/C33M, uniformly graded. Provide aggregates from a single source.

C. Air-Entraining Admixture: ASTM C260/C260M.

D. Chemical Admixtures: Admixtures certified by manufacturer to be compatible with other admixtures and to contain not more than 0.1 percent water-soluble chloride ions by mass of cementitious material.

1. Water-Reducing Admixture: ASTM C494/C494M, Type A.

2. Retarding Admixture: ASTM C494/C494M, Type B.
3. Water-Reducing and Retarding Admixture: ASTM C494/C494M, Type D.
4. High-Range, Water-Reducing Admixture: ASTM C494/C494M, Type F.
5. High-Range, Water-Reducing and Retarding Admixture: ASTM C494/C494M, Type G.
6. Plasticizing and Retarding Admixture: ASTM C1017/C1017M, Type II.

E. Water: Potable and complying with ASTM C94/C94M.

2.5 CURING MATERIALS

A. Absorptive Cover: AASHTO M 182, Class 3, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. dry.

B. Moisture-Retaining Cover: ASTM C171, polyethylene film or white burlap-polyethylene sheet.

C. Water: Potable.

D. Evaporation Retarder: Waterborne, monomolecular, film forming, manufactured for application to fresh concrete.

E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C309, Type 1, Class B, dissipating.

2.6 RELATED MATERIALS

A. Joint Fillers: ASTM D1751, asphalt-saturated cellulosic fiber in preformed strips.

2.7 CONCRETE MIXTURES

A. Prepare design mixtures, proportioned according to ACI 301, for each type and strength of normal-weight concrete, and as determined by either laboratory trial mixtures or field experience.

1. Use a qualified independent testing agency for preparing and reporting proposed concrete design mixtures for the trial batch method.
2. When automatic machine placement is used, determine design mixtures and obtain laboratory test results that comply with or exceed requirements.

B. Concrete Mixtures: Normal-weight concrete.

1. Compressive Strength (28 Days): 4500 psi.

2.8 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, and mix concrete materials and concrete according to ASTM C94/C94M. Furnish batch certificates for each batch discharged and used in the Work.

1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

B. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete according to ASTM C94/C94M. Mix concrete materials in appropriate drum-type batch machine mixer.

1. For concrete batches of 1 cu. yd. or smaller, continue mixing at least 1-1/2 minutes, but not more than 5 minutes after ingredients are in mixer, before any part of batch is released.
2. For concrete batches larger than 1 cu. yd., increase mixing time by 15 seconds for each additional 1 cu. yd..
3. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mixture type, mixing time, quantity, and amount of water added.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine exposed subgrades and subbase surfaces for compliance with requirements for dimensional, grading, and elevation tolerances.

B. Proof-roll prepared subbase surface below concrete paving to identify soft pockets and areas of excess yielding.

1. Completely proof-roll subbase in one direction and repeat in perpendicular direction. Limit vehicle speed to 3 mph.
2. Proof-roll with a pneumatic-tired and loaded, 10-wheel, tandem-axle dump truck weighing not less than 15 tons.
3. Correct subbase with soft spots and areas of pumping or rutting exceeding depth of 1/2 inch according to requirements in Section 312000 "Earth Moving."

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Remove loose material from compacted subbase surface immediately before placing concrete.

3.3 EDGE FORMS AND SCREED CONSTRUCTION

A. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides to required lines, grades, and elevations. Install forms to allow continuous progress of work and so forms can remain in place at least 24 hours after concrete placement.

B. Clean forms after each use and coat with form-release agent to ensure separation from concrete without damage.

3.4 INSTALLATION OF STEEL REINFORCEMENT

A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.

B. Clean reinforcement of loose rust and mill scale, earth, ice, or other bond-reducing materials.

C. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement. Maintain minimum cover to reinforcement.

D. Install welded-wire reinforcement in lengths as long as practicable. Lap adjoining pieces at least one full mesh, and lace splices with wire. Offset laps of adjoining widths to prevent continuous laps in either direction.

E. Zinc-Coated Reinforcement: Use galvanized-steel wire ties to fasten zinc-coated reinforcement. Repair cut and damaged zinc coatings with zinc repair material.

F. Epoxy-Coated Reinforcement: Use epoxy-coated steel wire ties to fasten epoxy-coated reinforcement. Repair cut and damaged epoxy coatings with epoxy repair coating according to ASTM D3963/D3963M.

G. Install fabricated bar mats in lengths as long as practicable. Handle units to keep them flat and free of distortions. Straighten bends, kinks, and other irregularities, or replace units as required before placement. Set mats for a minimum 2-inch overlap of adjacent mats.

3.5 JOINTS

A. General: Form construction, isolation, and contraction joints and tool edges true to line, with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to centerline unless otherwise indicated.

1. When joining existing paving, place transverse joints to align with previously placed joints unless otherwise indicated.

B. Construction Joints: Set construction joints at side and end terminations of paving and at locations where paving operations are stopped for more than one-half hour unless paving terminates at isolation joints.

1. Continue steel reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of paving strips unless otherwise indicated.
2. Provide tie bars at sides of paving strips where indicated.
3. Butt Joints: Use bonding agent or epoxy-bonding adhesive at joint locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
4. Keyed Joints: Provide preformed keyway-section forms or bulkhead forms with keys unless otherwise indicated. Embed keys at least 1-1/2 inches into concrete.
5. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or coat with asphalt one-half of dowel length to prevent concrete bonding to one side of joint.

C. Isolation Joints: Form isolation joints of preformed joint-filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, other fixed objects, and where indicated.

1. Locate expansion joints at intervals of 50 feet unless otherwise indicated.
2. Extend joint fillers full width and depth of joint.
3. Terminate joint filler not less than 1/2 inch or more than 1 inch below finished surface if joint sealant is indicated.
4. Place top of joint filler flush with finished concrete surface if joint sealant is not indicated.
5. Furnish joint fillers in one-piece lengths. Where more than one length is required, lace or clip joint-filler sections together.

6. During concrete placement, protect top edge of joint filler with metal, plastic, or other temporary preformed cap. Remove protective cap after concrete has been placed on both sides of joint.

D. Contraction Joints: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of the concrete thickness, as follows, to match jointing of existing adjacent concrete paving:

1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint with grooving tool to a 1/4-inch radius. Repeat grooving of contraction joints after applying surface finishes. Eliminate grooving-tool marks on concrete surfaces.

   a. Tolerance: Ensure that grooved joints are within 3 inches either way from centers of dowels.

2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before developing random contraction cracks.

   a. Tolerance: Ensure that sawed joints are within 3 inches either way from centers of dowels.

3. Doweled Contraction Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or coat with asphalt one-half of dowel length to prevent concrete bonding to one side of joint.

E. Edging: After initial floating, tool edges of paving, gutters, curbs, and joints in concrete with an edging tool to a 1/4-inch radius. Repeat tooling of edges after applying surface finishes. Eliminate edging-tool marks on concrete surfaces.

3.6 CONCRETE PLACEMENT

A. Before placing concrete, inspect and complete formwork installation, steel reinforcement, and items to be embedded or cast-in.

B. Remove snow, ice, or frost from subbase surface and steel reinforcement before placing concrete. Do not place concrete on frozen surfaces.

C. Moisten subbase to provide a uniform dampened condition at time concrete is placed. Do not place concrete around manholes or other structures until they are at required finish elevation and alignment.

D. Comply with ACI 301 requirements for measuring, mixing, transporting, and placing concrete.

E. Do not add water to concrete during delivery or at Project site. Do not add water to fresh concrete after testing.

F. Deposit and spread concrete in a continuous operation between transverse joints. Do not push or drag concrete into place or use vibrators to move concrete into place.

G. Consolidate concrete according to ACI 301 by mechanical vibrating equipment supplemented by hand spading, rodding, or tamping.

1. Consolidate concrete along face of forms and adjacent to transverse joints with an internal vibrator. Keep vibrator away from joint assemblies, reinforcement, or side forms. Use only square-faced shovels for hand spreading and consolidation. Consolidate with care to prevent dislocating reinforcement, dowels and joint devices.

H. Screed paving surface with a straightedge and strike off.

I. Commence initial floating using bull floats or darbies to impart an open-textured and uniform surface plane before excess moisture or bleedwater appears on the surface. Do not further disturb concrete surfaces before beginning finishing operations or spreading surface treatments.

J. Curbs and Gutters: Use design mixture for automatic machine placement. Produce curbs and gutters to required cross section, lines, grades, finish, and jointing.

K. Slip-Form Paving: Use design mixture for automatic machine placement. Produce paving to required thickness, lines, grades, finish, and jointing.

1. Compact subbase and prepare subgrade of sufficient width to prevent displacement of slip-form paving machine during operations.

3.7 FLOAT FINISHING

A. General: Do not add water to concrete surfaces during finishing operations.

B. Float Finish: Begin the second floating operation when bleedwater sheen has disappeared and concrete surface has stiffened sufficiently to permit operations. Float surface with power-driven floats or by hand floating if area is small or inaccessible to power units. Finish surfaces to true planes. Cut down high spots and fill low spots. Refloat surface immediately to uniform granular texture.

1. Medium-to-Fine-Textured Broom Finish: Draw a soft-bristle broom across float-finished concrete surface, perpendicular to line of traffic, to provide a uniform, fine-line texture.

3.8 CONCRETE PROTECTION AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.

B. Comply with ACI 306.1 for cold-weather protection.

C. Evaporation Retarder: Apply evaporation retarder to concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete but before float finishing.

D. Begin curing after finishing concrete but not before free water has disappeared from concrete surface.

E. Curing Methods: Cure concrete by moisture curing, moisture-retaining-cover curing, curing compound, or a combination of these as follows:

1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:

a. Water.
b. Continuous water-fog spray.
c. Absorptive cover, water saturated and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.

2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Immediately repair any holes or tears occurring during installation or curing period, using cover material and waterproof tape.

3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating, and repair damage during curing period.

3.9 PAVING TOLERANCES

A. Comply with tolerances in ACI 117 and as follows:

1. Elevation: 3/4 inch.
2. Thickness: Plus 3/8 inch, minus 1/4 inch.
3. Surface: Gap below 10-feet- long; unleveled straightedge not to exceed 1/2 inch.
4. Alignment of Tie-Bar End Relative to Line Perpendicular to Paving Edge: 1/2 inch per 12 inches of tie bar.
5. Lateral Alignment and Spacing of Dowels: 1 inch.
6. Vertical Alignment of Dowels: 1/4 inch.
7. Alignment of Dowel-Bar End Relative to Line Perpendicular to Paving Edge: 1/4 inch per 12 inches of dowel.
8. Joint Spacing: 3 inches.
9. Contraction Joint Depth: Plus 1/4 inch, no minus.
10. Joint Width: Plus 1/8 inch, no minus.
11. ADA accessible pathways are to be constructed with a maximum of 5% running slope and a 2% cross slope. There is no tolerance for exceeding these slopes.
12. ADA accessible ramps, with handrails, are to be constructed with a maximum running slope of 8.33% (1:12). There is no tolerance for exceeding these slopes.
13. Landings within an ADA accessible pathway or ramp shall be sloped at 2% or less in all directions. There is no tolerance for exceeding these slopes.
14. ADA accessible parking shall be sloped at 2% or less in all directions. There is no tolerance for exceeding these slopes.

3.10 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Testing Services: Testing and inspecting of composite samples of fresh concrete obtained according to ASTM C172/C172M shall be performed according to the following requirements:

1. Testing Frequency: Obtain at least one composite sample for each 100 cu. yd. or 5000 sq. ft. or fraction thereof of each concrete mixture placed each day.

a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.

2. Slump: ASTM C143/C143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
3. Air Content: ASTM C231/C231M, pressure method; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
4. Concrete Temperature: ASTM C1064/C1064M; one test hourly when air temperature is 40 deg F and below and when it is 80 deg F and above, and one test for each composite sample.
5. Compression Test Specimens: ASTM C31/C31M; cast and laboratory cure one set of three standard cylinder specimens for each composite sample.
6. Compressive-Strength Tests: ASTM C39/C39M; test one specimen at seven days and two specimens at 28 days.

    a. A compressive-strength test shall be the average compressive strength from two specimens obtained from same composite sample and tested at 28 days.

C. Strength of each concrete mixture will be satisfactory if average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.

D. Test results shall be reported in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.

E. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.

F. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect.

G. Concrete paving will be considered defective if it does not pass tests and inspections.

H. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

I. Prepare test and inspection reports.

3.11 REPAIR AND PROTECTION

A. Remove and replace concrete paving that is broken, damaged, or defective or that does not comply with requirements in this Section. Remove work in complete sections from joint to joint unless otherwise approved by Architect.

B. Drill test cores, where directed by Architect, when necessary to determine magnitude of cracks or defective areas. Fill drilled core holes in satisfactory paving areas with portland cement concrete bonded to paving with epoxy adhesive.

C. Protect concrete paving from damage. Exclude traffic from paving for at least 14 days after placement. When construction traffic is permitted, maintain paving as clean as possible by removing surface stains and spillage of materials as they occur.

D. Maintain concrete paving free of stains, discoloration, dirt, and other foreign material. Sweep paving not more than two days before date scheduled for Substantial Completion inspections.

END OF SECTION

SECTION 32 13 13.33 - CONCRETE PAVING FOR SIDEWALKS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Type 1 Pavement – broom finish
2. Type 2 Pavement – exposed aggregate finish

B. Related Sections:

1. Division 03 Section "Miscellaneous Cast-in-Place Concrete" for general building applications of concrete.
2. Division 32 Section "Concrete Paving Joint Sealants for Sidewalks" for joint sealants in expansion and contraction joints within concrete paving and in joints between concrete paving and asphalt paving or adjacent construction.

1.2 DEFINITIONS

A. Cementitious Materials: Portland cement alone or in combination with one or more of blended hydraulic cement, fly ash and other pozzolans, and ground granulated blast-furnace slag.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. LEED Submittals:

1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and pre-consumer recycled content. Include statement indicating cost for each product having recycled content.
2. Design Mixtures for Credit ID 1: For each concrete mixture containing fly ash as a replacement for portland cement or other portland cement replacements. For each design mixture submitted, include an equivalent concrete mixture that does not contain portland cement replacements, to determine amount of portland cement replaced.

C. Samples for Initial Selection: For each type of product, ingredient, or admixture requiring color selection.

1. Exposed Aggregate 5 lb. (2.3 kg) sample.

D. Samples for Verification: For each type of product or exposed finish, prepared as Samples of size indicated below:

1. Exposed Aggregate: 5-lb (2.3-kg) Sample of each mix.

E. Other Action Submittals:

1. Design Mixtures: For each concrete paving mixture. Include alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified ready-mix concrete manufacturer and testing agency.

B. Material Certificates: For the following, from manufacturer:

1. Cementitious materials.
2. Steel reinforcement and reinforcement accessories.
3. Fiber reinforcement.
4. Admixtures.
5. Curing compounds.
6. Applied finish materials.
7. Bonding agent or epoxy adhesive.
8. Joint fillers.

C. Material Test Reports: For each of the following:

1. Aggregates. Include service-record data indicating absence of deleterious expansion of concrete due to alkali-aggregate reactivity.

D. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. Ready-Mix-Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products, including exposed aggregate finishes, and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.

1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities" (Quality Control Manual - Section 3, "Plant Certification Checklist").

B. Testing Agency Qualifications: Qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.

1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.

C. Concrete Testing Service: Engage a qualified testing agency to perform material evaluation tests and to design concrete mixtures.

D. ACI Publications: Comply with ACI 301 (ACI 301M) unless otherwise indicated.

E. Mockups: Build mockups of exposed aggregate concrete to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Build mockups of full-thickness sections of concrete paving to demonstrate typical joints; surface finish, texture, and color; curing; and standard of workmanship.

2. Build mockups of concrete paving in the location and of the size indicated or, if not indicated, build mockups where directed by Landscape Architect and not less than 96 inches (2400 mm) by 96 inches (2400 mm). Build exposed aggregate mockups in both retarder strengths indicated below.
3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Landscape Architect specifically approves such deviations in writing.
4. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

F. Preinstallation Conference: Conduct conference at Project site.

1. Review methods and procedures related to concrete paving, including but not limited to, the following:

   a. Concrete mixture design.
   b. Quality control of concrete materials and concrete paving construction practices including exposed aggregate finishing.

2. Require representatives of each entity directly concerned with concrete paving to attend, including the following:

   a. Contractor's superintendent.
   b. Ready-mix concrete manufacturer.
   c. Concrete paving subcontractor.
   d. Manufacturer's representative of retarder system used for exposed aggregate paving.

1.6 PROJECT CONDITIONS

A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.

PART 2 - PRODUCTS

2.1 FORMS

A. Form Materials: Plywood, metal, metal-framed plywood, or other approved panel-type materials to provide full-depth, continuous, straight, and smooth exposed surfaces.

1. Use flexible or uniformly curved forms for curves with a radius of 100 feet (30.5 m) or less to maintain smooth, continuous curves. Do not use notched and bent forms.

B. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and that will not impair subsequent treatments of concrete surfaces.

2.2 STEEL REINFORCEMENT

A. Epoxy-Coated Welded Wire Reinforcement: ASTM A 884/A 884M, Class A, plain steel.

B. Epoxy-Coated, Joint Dowel Bars: ASTM A 775/A 775M; with ASTM A 615/A 615M, Grade 60 (Grade 420), plain-steel bars.

C. Tie Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), deformed.

D. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars, welded wire reinforcement, and dowels in place. Manufacture bar supports according to CRSI's "Manual of Standard Practice" from plastic of greater compressive strength than concrete specified, and as follows:

E. Epoxy Repair Coating: Liquid, two-part, epoxy repair coating, compatible with epoxy coating on reinforcement.

2.3 CONCRETE MATERIALS

A. Cementitious Material: Use the following cementitious materials, of same type, brand, and source throughout Project:

1. Portland Cement: ASTM C 150, gray portland cement Type II. Supplement with the following:

    a. Fly Ash: ASTM C 618, Class C or Class F.
    b. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.

B. Normal-Weight Aggregates: ASTM C 33, Class 4S, uniformly graded. Provide aggregates from a single source.

1. Maximum Coarse-Aggregate Size: 3/4 inch (19 mm) nominal.
2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

C. Exposed Aggregate: Selected, hard, and durable; washed; free of materials with deleterious reactivity to cement or that cause staining; from a single source, with gap-graded coarse aggregate as follows:

1. Aggregate Sizes: 3/8-to-5/8-inch (10 to 16 mm) nominal.
2. Aggregate Source, Shape, and Color: Rounded, multicolored (Grey, Brown, Blue, Red) stone
3. Stone type: Delaware River Jacks
4. Aggregate Source: NJ Gravel & Sand Co:

    a. 1661 Hwy 34 South
    Wall, NJ 07719
    Phone: 732-410-7172
    Email: info@njgravelsand.com
    b. Or approved equal.

D. Water: Potable and complying with ASTM C 94/C 94M.

E. Air-Entraining Admixture: ASTM C 260.

F. Chemical Admixtures: Admixtures certified by manufacturer to be compatible with other admixtures and to contain not more than 0.1 percent water-soluble chloride ions by mass of cementitious material.

1. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.

2.4 FIBER REINFORCEMENT

A. Synthetic Fiber: Fibrillated polypropylene fibers engineered and designed for use in concrete paving, complying with ASTM C 1116/C 1116M, Type III, 1/2 to 1-1/2 inches (13 to 38 mm) long.

2.5 CURING MATERIALS

A. Absorptive Cover: AASHTO M 182, Class 3, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. (305 g/sq. m) dry or cotton mats.

B. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.

C. Water: Potable.

D. Evaporation Retarder: Waterborne, monomolecular, film forming, manufactured for application to fresh concrete.

E. Retardant for Exposed Aggregate: Lithocast Surface Retarder

1. Manufacturer: L.M. Scofield Company
   Telephone 800-800-9900
   Website: www.scofield.com
2. To be selected at mockup stage between:

   a. Lithocast Surface Retarder 15
   b. Lithocast Surface Retarder 50

3. Or approved equal.

F. Curing Paper:

1. Nonstaining, waterproof paper, consisting of two layers of kraft paper cemented together and reinforced with fibber and complying with ASTM C 17.

2.6 PROTECTIVE LAYER

A. Manufacturers: Subject to compliance with requirements,

1. Manufacturer: L.M. Scofield Company
   Telephone: 800-800-9900
   Website: www.scofield.com
2. Or approved equal.

B. Repello FPS: Breathable non-film forming surface treatment.

1. Blend of inorganic fluorinated polysiloxane polymer
2. Low odor water based
3. Exterior and UV light stable
4. Colorless

5. Use and store according to manufacturer's directions.

2.7 RELATED MATERIALS

A. Joint Fillers for Expansion Joint EJ1: ASTM D 1751, asphalt-saturated cellulosic fiber in preformed strips as designated on the drawings.

B. Joint Fillers for Expansion Joint EJ2: self-expanding cork in preformed strips as designated on the drawings.

C. Bonding Agent: ASTM C 1059, Type II, non-redispersible, acrylic emulsion or styrene butadiene.

D. Epoxy Bonding Adhesive: ASTM C 881/C 881M, two-component epoxy resin capable of humid curing and bonding to damp surfaces; of class suitable for application temperature, of grade complying with requirements, and of the following types:

1. Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.

2.8 CONCRETE MIXTURES

A. Prepare design mixtures, proportioned according to ACI 301 (ACI 301M), for each type and strength of normal-weight concrete, and as determined by either laboratory trial mixtures or field experience.

1. Use a qualified independent testing agency for preparing and reporting proposed concrete design mixtures for the trial batch method.

B. Proportion mixtures to provide normal-weight concrete with the following properties:

1. Compressive Strength (28 Days): 4000 psi (27.6 MPa)
2. Maximum Water-Cementitious Materials Ratio at Point of Placement: 0.45.
3. Slump Limit: 4 inches (100 mm), plus or minus 1 inch (25 mm).

C. Add air-entraining admixture at manufacturer's prescribed rate to result in normal-weight concrete at point of placement having an air content as follows:

1. Air Content: **5** percent plus or minus 1.5 percent for 3/42-inch (19-mm) nominal maximum aggregate size.

D. Limit water-soluble, chloride-ion content in hardened concrete to 0.15 percent by weight of cement.

E. Chemical Admixtures: Use admixtures according to manufacturer's written instructions.

1. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions and when they do not affect the effectiveness of the color, retardant or sealant.

F. Cementitious Materials: Use fly ash, pozzolan, ground granulated blast-furnace slag, and silica fume as needed to reduce the total amount of portland cement, which would otherwise be used, by not less than 40 percent.

G. Synthetic Fiber: Uniformly disperse in concrete mixture at manufacturer's recommended rate, but not less than 1.0 lb/cu. yd. (0.60 kg/cu. m).

2.9 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M and ASTM C 1116/C 1116M. Furnish batch certificates for each batch discharged and used in the Work.

1. When air temperature is between 85 and 90 deg F (30 and 32 deg C), reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F (32 deg C), reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine exposed subgrades and subbase surfaces for compliance with requirements for dimensional, grading, and elevation tolerances.

B. Proof-roll prepared subbase surface below concrete paving to identify soft pockets and areas of excess yielding.

1. Completely proof-roll subbase in one direction**.** Limit vehicle speed to 3 mph (5 km/h).
2. Proof-roll with a pneumatic-tired and loaded, 10-wheel, tandem-axle dump truck weighing not less than 15 tons (13.6 tonnes).
3. Correct subbase with soft spots and areas of pumping or rutting exceeding depth of 1/2 inch (13 mm) according to requirements in Division 31 Section "Earth Moving."

C. Proceed with installation only after inspection and approval by Landscape Architect and unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Remove loose material from compacted subbase surface immediately before placing concrete.

3.3 EDGE FORMS AND SCREED CONSTRUCTION

A. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides to required lines, grades, and elevations. Install forms to allow continuous progress of work and so forms can remain in place at least 24 hours after concrete placement.

B. Clean forms after each use and coat with form-release agent to ensure separation from concrete without damage.

3.4 STEEL REINFORCEMENT

A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.

B. Clean reinforcement of loose rust and mill scale, earth, ice, or other bond-reducing materials.

C. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement. Maintain minimum cover to reinforcement.

D. Install welded wire reinforcement in lengths as long as practicable. Lap adjoining pieces at least one full mesh, and lace splices with wire. Offset laps of adjoining widths to prevent continuous laps in either direction.

E. Epoxy-Coated Reinforcement: Use epoxy-coated steel wire ties to fasten epoxy-coated reinforcement. Repair cut and damaged epoxy coatings with epoxy repair coating according to ASTM D 3963/D 3963M.

3.5 JOINTS

A. General: Form construction, isolation, and contraction joints and tool edges true to line, with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to centerline unless otherwise indicated.

1. When joining existing paving, place transverse joints to align with previously placed joints unless otherwise indicated.

B. Construction Joints: Set construction joints at side and end terminations of paving and at locations where paving operations are stopped for more than one-half hour unless paving terminates at isolation joints.

1. Continue steel reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of paving strips unless otherwise indicated.
2. Provide tie bars at sides of paving strips where indicated.
3. Butt Joints: Use bonding agent at joint locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
4. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or coat with asphalt one-half of dowel length to prevent concrete bonding to one side of joint.

C. Isolation Joints: Form isolation joints of preformed joint-filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, other fixed objects, and where indicated.

1. Locate expansion joints at intervals of 50 feet (15.25 m) unless otherwise indicated.
2. Extend joint fillers full width and depth of joint.
3. Terminate joint filler not less than 1/2 inch (13 mm) or more than 1 inch (25 mm) below finished surface if joint sealant is indicated.
4. Place top of joint filler flush with finished concrete surface if joint sealant is not indicated.
5. Furnish joint fillers in one-piece lengths. Where more than one length is required, lace or clip joint-filler sections together.
6. During concrete placement, protect top edge of joint filler with metal, plastic, or other temporary preformed cap. Remove protective cap after concrete has been placed on both sides of joint.

D. Control Joints: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of the concrete thickness, as follows:

1. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- (3-mm-) wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before developing random contraction cracks.

    a. Tolerance: Ensure that sawed joints are within 3 inches (75 mm) either way from centers of dowels.

E. Edging: After initial floating, tool edges of paving, gutters, curbs, and joints in concrete with an edging tool to a 1/4-inch (6-mm) radius. Repeat tooling of edges after applying surface finishes. Eliminate edging-tool marks on concrete surfaces.

3.6 CONCRETE PLACEMENT

A. Before placing concrete, inspect and complete formwork installation, steel reinforcement, and items to be embedded or cast-in.

B. Remove snow, ice, or frost from subbase surface and steel reinforcement before placing concrete. Do not place concrete on frozen surfaces.

C. Remove organic materials from the subbase surface and steel reinforcement before placing concrete.

D. Moisten subbase to provide a uniform dampened condition at time concrete is placed.

E. Do not place concrete around manholes or other structures until they are at required finish elevation and alignment.

F. Comply with ACI 301 (ACI 301M) requirements for measuring, mixing, transporting, and placing concrete.

G. Do not add water to concrete during delivery or at Project site. Do not add water to fresh concrete after testing.

H. Deposit and spread concrete in a continuous operation between transverse joints. Do not push or drag concrete into place or use vibrators to move concrete into place.

I. Consolidate concrete according to ACI 301 (ACI 301M) by mechanical vibrating equipment supplemented by hand spading, rodding, or tamping.

    1. Consolidate concrete along face of forms and adjacent to transverse joints with an internal vibrator. Keep vibrator away from joint assemblies**,** reinforcement, or side forms. Use only square-faced shovels for hand spreading and consolidation. Consolidate with care to prevent dislocating reinforcement, dowels and joint devices.

J. Screed paving surface with a straightedge and strike off.

K. Commence initial floating using bull floats or darbies to impart an open-textured and uniform surface plane before excess moisture or bleed water appears on the surface. Do not further disturb concrete surfaces before beginning finishing operations or spreading surface treatments.

    1. Compact subbase and prepare subgrade of sufficient width to prevent displacement of slip-form paving machine during operations.

L. Cold-Weather Placement: Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing, or low temperatures. Comply with ACI 306.1 and the following:

1. When air temperature has fallen to or is expected to fall below 40 deg F (4.4 deg C), uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F (10 deg C) and not more than 80 deg F (27 deg C) at point of placement.
2. Do not use frozen materials or materials containing ice or snow.
3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in design mixtures.

M. Hot-Weather Placement: Comply with ACI 301 (ACI 301M) and as follows when hot-weather conditions exist:

1. Cool ingredients before mixing to maintain concrete temperature below 90 deg F (32 deg C) at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated in total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
2. Cover steel reinforcement with water-soaked burlap so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.
3. Fog-spray forms**,** steel reinforcement, and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

3.7 FLOAT FINISHING

A. General: Do not add water to concrete surfaces during finishing operations.

B. Float Finish: Begin the second floating operation when bleed-water sheen has disappeared, and concrete surface has stiffened sufficiently to permit operations. Float surface with power-driven floats or by hand floating if area is small or inaccessible to power units. Finish surfaces to true planes. Cut down high spots and fill low spots. Refloat surface immediately to uniform granular texture.

1. Paving Type 1 - Medium-to-Coarse-Textured Broom Finish: Provide a coarse finish by striating float-finished concrete surface 1/16 to 1/8 inch (1.6 to 3 mm) deep with a stiff-bristled broom, perpendicular to line of traffic.

3.8 SPECIAL FINISHES

A. Paving Type 2 - Monolithic Exposed-Aggregate Finish: Expose coarse aggregate in paving surface as follows:

1. Immediately after float finishing, spray-apply chemical surface retarder to paving according to manufacturer's written instructions.
2. Cover paving surface with plastic sheeting, sealing laps with tape, and remove when ready to continue finishing operations.
3. Without dislodging aggregate, remove mortar concealing the aggregate by lightly brushing surface with a stiff, nylon-bristle broom. Do not expose more than one-third of the average diameter of the aggregate and not more than one-half of the diameter of the smallest aggregate.
4. Fine-spray surface with water and brush. Repeat cycle of water flushing and brushing until cement film is removed from aggregate surfaces to depth required.

3.9 CONCRETE PROTECTION AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.

B. Comply with ACI 306.1 for cold-weather protection.

C. Evaporation Retarder: Apply evaporation retarder to concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h (1 kg/sq. m x h) before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete but before float finishing.

D. Begin curing after finishing concrete but not before free water has disappeared from concrete surface.

E. Curing Methods: Cure concrete by moisture-retaining-cover curing or a combination of these as follows:

1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:

   a. Water.
   b. Continuous water-fog spray.
   c. Absorptive cover, water saturated and kept continuously wet. Cover concrete surfaces and edges with 12-inch (300-mm) lap over adjacent absorptive covers.

2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover, placed in widest practicable width, with sides and ends lapped at least 12 inches (300 mm) and sealed by waterproof tape or adhesive. Immediately repair any holes or tears occurring during installation or curing period using cover material and waterproof tape.

3.10 PAVING TOLERANCES

A. Comply with tolerances in ACI 117 and as follows:

1. Must meet grades of adjoining surfaces smooth and level.
2. Elevation: 3/4 inch (19 mm).
3. Thickness: Plus 3/8 inch (10 mm), minus 1/4 inch (6 mm).
4. Surface: Gap below 10-foot- (3-m-) long, unleveled straightedge not to exceed 1/2 inch (13 mm).
5. Alignment of Tie-Bar End Relative to Line Perpendicular to Paving Edge: 1/2 inch per 12 inches (13 mm per 300 mm) of tie bar.
6. Lateral Alignment and Spacing of Dowels: 1 inch (25 mm).
7. Vertical Alignment of Dowels: 1/4 inch (6 mm).
8. Alignment of Dowel-Bar End Relative to Line Perpendicular to Paving Edge: 1/4 inch per 12 inches (6 mm per 300 mm) of dowel.
9. Joint Spacing: 3 inches (75 mm).
10. Contraction Joint Depth: Plus 1/4 inch (6 mm), no minus.
11. Joint Width: Plus 1/8 inch (3 mm), no minus.

3.11 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Testing Services: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:

1. Testing Frequency: Obtain at least one composite sample for each 100 cu. yd. (76 cu. m) or fraction thereof of each concrete mixture placed each day.

    a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.

2. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
3. Air Content: ASTM C 231, pressure method; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
4. Concrete Temperature: ASTM C 1064/C 1064M; one test hourly when air temperature is 40 deg F (4.4 deg C) and below and when it is 80 deg F (27 deg C) and above, and one test for each composite sample.
5. Compression Test Specimens: ASTM C 31/C 31M; cast and laboratory cure one set of three standard cylinder specimens for each composite sample.
6. Compressive-Strength Tests: ASTM C 39/C 39M; test one specimen at seven days and two specimens at 28 days.

    a. A compressive-strength test shall be the average compressive strength from two specimens obtained from same composite sample and tested at 28 days.

C. Strength of each concrete mixture will be satisfactory if average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi (3.4 MPa).

D. Test results shall be reported in writing to Landscape Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.

E. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Landscape Architect but will not be used as sole basis for approval or rejection of concrete.

F. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Landscape Architect.

G. Concrete paving will be considered defective if it does not pass tests and inspections.

H. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

I. Prepare test and inspection reports.

3.12 REPAIRS AND PROTECTION

A. Remove and replace concrete paving that is broken, damaged, or defective or that does not comply with requirements in this Section. Remove work in complete sections from joint to joint unless otherwise approved by Landscape Architect.

B. Drill test cores, where directed by Landscape Architect, when necessary to determine magnitude of cracks or defective areas. Fill drilled core holes in satisfactory paving areas with portland cement concrete bonded to paving with epoxy adhesive.

C. Protect concrete paving from damage. Exclude traffic from paving for at least 14 days after placement. When construction traffic is permitted, maintain paving as clean as possible by removing surface stains and spillage of materials as they occur.

D. Maintain concrete paving free of stains, discoloration, dirt, and other foreign material. Sweep paving not more than two days before date scheduled for Substantial Completion inspections.

E. Cover finished cured concrete to protect from other construction activity.

END OF SECTION

This page is intentionally left blank.

SECTION 32 13 73 - CONCRETE PAVING JOINT SEALANTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Cold-applied joint sealants.
2. Hot-applied joint sealants.
3. Joint-sealant backer materials.
4. Primers.

B. Related Requirements:

1. Section 079200 "Joint Sealants" for sealing nontraffic and traffic joints in locations not specified in this Section.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data:

1. Concrete pavement joint sealants.
2. Joint-sealant backer materials.

B. Samples for Initial Selection: Manufacturer's standard color sheets, showing full range of available colors for each type of joint sealant.

C. Samples for Verification: Actual sample of finished products for each kind and color of joint sealant required.

1. Size: Joint sealants in 1/2-inch-wide joints formed between two 6-inch-long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.

D. Paving-Joint-Sealant Schedule: Include the following information:

1. Joint-sealant application, joint location, and designation.
2. Joint-sealant manufacturer and product name.
3. Joint-sealant formulation.
4. Joint-sealant color.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Statements: For Installer.

1.5 QUALITY ASSURANCE

A. Qualifications:

1. Installers: Entity that employs installers and supervisors who are trained and approved by manufacturer.

1.6 PRECONSTRUCTION TESTING

A. Preconstruction Testing: Performed by a qualified testing agency.

1.7 FIELD CONDITIONS

A. Do not proceed with installation of joint sealants under the following conditions:

1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg F.
2. When joint substrates are wet.
3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Obtain joint sealants from single manufacturer.

2.2 JOINT SEALANTS, GENERAL

A. Compatibility: Provide joint sealants, backer materials, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.

2.3 COLD-APPLIED JOINT SEALANTS

A. Single-Component, Nonsag, Silicone Joint Sealant: ASTM D5893/D5893M, Type NS.

B. Single-Component, Self-Leveling, Silicone Joint Sealant: ASTM D5893/D5893M, Type SL.

C. Multicomponent, Nonsag, Urethane, Elastomeric Joint Sealant: ASTM C920, Type M, Grade NS, Class 25, for Use T.

2.4 HOT-APPLIED JOINT SEALANTS

A. Hot-Applied, Single-Component Joint Sealant, Type I: ASTM D6690.

B. Hot-Applied, Single-Component Joint Sealant, Type I or Type II: ASTM D6690.

C. Hot-Applied, Single-Component Joint Sealant, Type I, II, or III: ASTM D6690.

D. Hot-Applied, Single-Component Joint Sealant, Type IV: ASTM D6690.

2.5 JOINT-SEALANT BACKER MATERIALS

A. Joint-Sealant Backer Materials: Nonstaining; compatible with joint substrates, sealants, primers, and other joint fillers; and approved for applications indicated by joint-sealant manufacturer, based on field experience and laboratory testing.

B. Round Backer Rods for Cold- and Hot-Applied Joint Sealants: ASTM D5249, Type 1, of diameter and density required to control sealant depth and prevent bottom-side adhesion of sealant.

C. Round Backer Rods for Cold-Applied Joint Sealants: ASTM D5249, Type 3, of diameter and density required to control joint-sealant depth and prevent bottom-side adhesion of sealant.

D. Backer Strips for Cold- and Hot-Applied Joint Sealants: ASTM D5249; Type 2; of thickness and width required to control joint-sealant depth, prevent bottom-side adhesion of sealant, and fill remainder of joint opening under sealant.

2.6 PRIMERS

A. Primers: Product recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine joints to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning of Joints: Before installing joint sealants, clean out joints immediately to comply with joint-sealant manufacturer's written instructions.

1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.

B. Joint Priming: Prime joint substrates where indicated or where recommended in writing by joint-sealant manufacturer, based on preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions.

Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

3.3 INSTALLATION OF JOINT SEALANTS

A. Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated unless more stringent requirements apply.

B. Joint-Sealant Installation Standard: Comply with recommendations in ASTM C1193 for use of joint sealants as applicable to materials, applications, and conditions.

C. Install joint-sealant backers to support joint sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.

1. Do not leave gaps between ends of joint-sealant backer materials.
2. Do not stretch, twist, puncture, or tear joint-sealant backer materials.
3. Remove absorbent joint-sealant backer materials that have become wet before sealant application and replace them with dry materials.

D. Install joint sealants immediately following backer material installation, using proven techniques that comply with the following:

1. Place joint sealants so they fully contact joint substrates.
2. Completely fill recesses in each joint configuration.
3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

E. Tooling of Nonsag Joint Sealants: Immediately after joint-sealant application and before skinning or curing begins, tool sealants in accordance with the following requirements to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint:

1. Remove excess joint sealant from surfaces adjacent to joints.
2. Use tooling agents that are approved in writing by joint-sealant manufacturer and that do not discolor sealants or adjacent surfaces.

F. Provide joint configuration to comply with joint-sealant manufacturer's written instructions unless otherwise indicated.

3.4 CLEANING AND PROTECTION

A. Clean off excess joint sealant as the Work progresses, by methods and with cleaning materials approved in writing by joint-sealant manufacturers.

B. Protect joint sealants, during and after curing period, from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately and replace with joint sealant so installations in repaired areas are indistinguishable from the original work.

END OF SECTION

This page is intentionally left blank.

SECTION 32 13 73.33 - CONCRETE PAVING JOINT SEALANTS FOR SIDEWALKS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Cold-applied joint sealants.
2. Joint-sealant backer materials.
3. Primers.

B. Related Requirements:

1. Section 079200 "Joint Sealants" for sealing nontraffic and traffic joints in locations not specified in this Section.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data:

1. Concrete pavement joint sealants.
2. Joint-sealant backer materials.

B. Samples for Initial Selection: Manufacturer's standard color sheets, showing full range of available colors for each type of joint sealant.

C. Samples for Verification: Actual sample of finished products for each kind and color of joint sealant required.

1. Size: Joint sealants in 1/2-inch- (13-mm-) wide joints formed between two 6-inch- (150-mm-) long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.

D. Paving-Joint-Sealant Schedule: Include the following information:

1. Joint-sealant application, joint location, and designation.
2. Joint-sealant manufacturer and product name.
3. Joint-sealant formulation.
4. Joint-sealant color.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Statements: For Installer.

1.5 QUALITY ASSURANCE

A. Qualifications:

1. Installers: Entity that employs installers and supervisors who are trained and approved by manufacturer.

1.6 PRECONSTRUCTION TESTING

A. Preconstruction Testing: Performed by a qualified testing agency.

1.7 FIELD CONDITIONS

A. Do not proceed with installation of joint sealants under the following conditions:

1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg F (5 deg C).
2. When joint substrates are wet.
3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Obtain joint sealants from single manufacturer for each sealant type.

2.2 JOINT SEALANTS, GENERAL

A. Compatibility: Provide joint sealants, backer materials, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.

2.3 COLD-APPLIED JOINT SEALANTS

A. Multicomponent, Nonsag, Urethane, Elastomeric Joint Sealant: ASTM C920, Type M, Grade NS, Class 25, for Use T.

2.4 JOINT-SEALANT BACKER MATERIALS

A. Joint-Sealant Backer Materials: Nonstaining; compatible with joint substrates, sealants, primers, and other joint fillers; and approved for applications indicated by joint-sealant manufacturer, based on field experience and laboratory testing.

B. Round Backer Rods for Cold- and Hot-Applied Joint Sealants: ASTM D5249, Type 1, of diameter and density required to control sealant depth and prevent bottom-side adhesion of sealant.

C. Round Backer Rods for Cold-Applied Joint Sealants: ASTM D5249, Type 3, of diameter and density required to control joint-sealant depth and prevent bottom-side adhesion of sealant.

2.5 PRIMERS

A. Primers: Product recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine joints to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning of Joints: Before installing joint sealants, clean out joints immediately to comply with joint-sealant manufacturer's written instructions.

1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.

B. Joint Priming: Prime joint substrates where indicated or where recommended in writing by joint-sealant manufacturer, based on preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

3.3 INSTALLATION OF JOINT SEALANTS

A. Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated unless more stringent requirements apply.

B. Joint-Sealant Installation Standard: Comply with recommendations in ASTM C1193 for use of joint sealants as applicable to materials, applications, and conditions.

C. Install joint-sealant backers to support joint sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.

1. Do not leave gaps between ends of joint-sealant backer materials.
2. Do not stretch, twist, puncture, or tear joint-sealant backer materials.
3. Remove absorbent joint-sealant backer materials that have become wet before sealant application and replace them with dry materials.

D. Install joint sealants immediately following backer material installation, using proven techniques that comply with the following:

1. Place joint sealants so they fully contact joint substrates.
2. Completely fill recesses in each joint configuration.
3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

E. Tooling of Nonsag Joint Sealants: Immediately after joint-sealant application and before skinning or curing begins, tool sealants in accordance with the following requirements to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint:

1. Remove excess joint sealant from surfaces adjacent to joints.
2. Use tooling agents that are approved in writing by joint-sealant manufacturer and that do not discolor sealants or adjacent surfaces.

F. Provide joint configuration to comply with joint-sealant manufacturer's written instructions unless otherwise indicated.

3.4 CLEANING AND PROTECTION

A. Clean off excess joint sealant as the Work progresses, by methods and with cleaning materials approved in writing by joint-sealant manufacturers.

B. Protect joint sealants, during and after curing period, from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately and replace with joint sealant so installations in repaired areas are indistinguishable from the original work.

END OF SECTION

SECTION 32 14 00 - UNIT PAVING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Stone pavers.

B. Related Requirements:

1. Section 07 14 13 “Hot Fluid-Applied Rubberized Asphalt Waterproofing” for waterproof membrane under setting bed.
2. Section 32 13 13 “Concrete Paving” for adjacent concrete paving materials.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data:

1. For materials other than water and aggregates.
2. For the following:

a. Pavers.
b. Mortar materials.

B. Samples for Verification:

1. Pavers: 12 by 12 inch units of each type of unit paver indicated.
2. Joint materials.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Material Certificates: For unit pavers. Include statements of material properties indicating compliance with requirements, including compliance with standards. Provide for each type and size of unit.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: A qualified unit paving installer. Installer's field supervisor must have Concrete Paver Installer Certification from the Interlocking Concrete Pavement Institute (ICPI) with the following designations:

1. Commercial Paver Technician Designation.

B. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.

1. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
2. Size: Four (4) full size pavers.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store pavers on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied.

B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.

C. Store liquids in tightly closed containers protected from freezing.

1.7 FIELD CONDITIONS

A. Cold-Weather Protection: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen subgrade or setting beds. Remove and replace unit paver work damaged by frost or freezing.

B. Weather Limitations for Mortar:

1. Cold-Weather Requirements: Comply with cold-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.
2. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6. Provide artificial shade and windbreaks and use cooled materials as required. Do not apply mortar to substrates with temperatures of 100 deg F and higher.

a. When ambient temperature exceeds 100 deg F, or when wind velocity exceeds 8 mph and ambient temperature exceeds 90 deg F, set pavers within 1 minute of spreading setting-bed mortar.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain each type of unit paver, joint material, and setting material from single source with resources to provide materials and products of consistent quality in appearance and physical properties.

2.2 STONE PAVERS

A. Granite Pavers: Rectangular paving slabs made from granite complying with ASTM C615/C615M.

1. Varieties and Sources: Subject to compliance with requirements, provide the following:

a. Black Hills Granites; Virginia Mist
b. Contact Information: 101 E. Culpeper Street, Suite 101, Culpeper, VA 22701; (540) 825-9044; sales@blackhillgranites.com.

2. Color and Grain: Dark gray with fine grain.
3. Finish: Thermal.
4. Match Architect's samples for color, finish, and other stone characteristics relating to aesthetic effects.
5. Thickness: Not less than 2 inches unless otherwise indicated.
6. Face Size: 24 by 24 inches.

2.3 MORTAR SETTING-BED MATERIALS

A. Regional Materials: To the extent required to comply with the minimum criteria specified in Section 01 81 13.14 “Sustainable Design Requirements,” manufacture aggregate for mortar and cement within 100 miles of Project site from materials that have been extracted, harvested, or recovered, as well as manufactured, within 100 miles of Project site.

B. Portland Cement: ASTM C150/C150M, Type I or Type II.

C. Sand: ASTM C144.

D. Latex Additive: Manufacturer's standard acrylic resin or styrene-butadiene-rubber water emulsion, serving as replacement for part or all of gaging water, of type specifically recommended by latex-additive manufacturer for use with field-mixed portland cement and aggregate mortar bed, and not containing a retarder.

E. Water: Potable.

2.4 MORTAR MIXES

A. General: Comply with referenced standards and with manufacturers' written instructions for mix proportions, mixing equipment, mixer speeds, mixing containers, mixing times, and other procedures needed to produce setting-bed and joint materials of uniform quality and with

optimal performance characteristics. Discard mortars if they have reached their initial set before being used.

B. Latex-Modified, Portland Cement Setting-Bed Mortar: Proportion and mix portland cement, sand, and latex additive for setting bed to comply with written instructions of latex-additive manufacturer and as necessary to produce stiff mixture with a moist surface when bed is ready to receive pavers.

2.5 AGGREGATE JOINT MATERIALS

A. Sand for Joints: Fine, sharp, washed, natural sand or crushed stone with 100 percent passing No. 16 sieve and no more than 10 percent passing No. 200 sieve.

1. Provide polymeric sand of color needed to produce required joint color.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine surfaces indicated to receive unit paving, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Where unit paving is to be installed over waterproofing, examine waterproofing installation, with waterproofing Installer present, for protection from paving operations, including areas where waterproofing system is turned up or flashed against vertical surfaces.

C. Proceed with installation only after unsatisfactory conditions have been corrected and waterproofing protection is in place.

3.2 INSTALLATION, GENERAL

A. Do not use unit pavers with chips, cracks, voids, discolorations, or other defects that might be visible or cause staining in finished work.

B. Mix pavers from several pallets or cubes, as they are placed, to produce uniform blend of colors and textures.

C. Cut unit pavers with motor-driven masonry saw equipment to provide clean, sharp, unchipped edges. Cut units to provide pattern indicated and to fit adjoining work neatly. Use full units without cutting where possible. Hammer cutting is not acceptable.

D. Joint Pattern: As indicated.

E. Pavers over Waterproofing: Exercise care in placing pavers and setting materials over waterproofing so protection materials are not displaced and waterproofing is not punctured or otherwise damaged. Carefully replace protection materials that become displaced and arrange for repair of damaged waterproofing before covering with paving.

1. Provide joint filler at waterproofing that is turned up on vertical surfaces.

F. Tolerances:

1. Do not exceed 1/32-inch unit-to-unit offset from flush (lippage) or 1/8 inch in 10 feet from level, or indicated slope, for finished surface of paving.

3.3 MORTAR SETTING-BED APPLICATIONS

A. Apply mortar-bed bond coat over surface of subbase about 15 minutes before placing mortar bed. Do not exceed 1/16-inch thickness for bond coat. Limit area of bond coat to avoid its drying out before placing setting bed.

B. Apply mortar bed over bond coat; spread and screed mortar bed to uniform thickness at subgrade elevations required for accurate setting of pavers to finished grades indicated.

C. Mix and place only that amount of mortar bed that can be covered with pavers before initial set. Before placing pavers, cut back, bevel edge, and remove and discard setting-bed material that has reached initial set.

D. Place pavers before initial set of cement occurs. Immediately before placing pavers on mortar bed, apply uniform 1/16-inch-thick bond coat to mortar bed or to back of each paver with a flat trowel.

E. Tamp or beat pavers with a wooden block or rubber mallet to obtain full contact with setting bed and to bring finished surfaces within indicated tolerances. Set each paver in a single operation before initial set of mortar; do not return to areas already set or disturb pavers for purposes of realigning finished surfaces or adjusting joints.

F. Spaced Joint Widths: Provide hand-tight joints.

G. Joint Installation:

1. Ensure pavers are completely dry.
2. Do not install in temperatures below 32 deg F.
3. Install polymeric joint material according to manufacturer’s written instructions including, but not limited to the following procedure:

a. Spread loose joint material over entire paver surface.
b. Sweep joint material to fully fill joints.
c. Sweep off excess joint material.
d. Protect paver surface and compact filled joints.
e. Wet joints with successive passes with a hose sprayer.
f. Blow off any excess water.

3.4 REPAIRING, POINTING, AND CLEANING

A. Remove and replace unit pavers that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Provide new units to match adjoining units and install in same manner as original units, with same joint treatment and with no evidence of replacement.

END OF SECTION

SECTION 32 17 13 - PARKING BUMPERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Precast concrete wheel stops.
2. Resilient wheel stops.
3. Resilient-shell, concrete-filled wheel stops.

1.2 ACTION SUBMITTALS

A. Product Data:

1. Precast concrete wheel stops.
2. Resilient wheel stops.
3. Resilient-shell, concrete-filled wheel stops

B. Sustainable Design Submittals:

1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.

C. Samples for Verification: For wheel stops, 6 inches long, showing color and cross section; with mounting hardware.

PART 2 - PRODUCTS

2.1 PARKING BUMPERS

A. Precast Concrete Wheel Stops: Precast, steel-reinforced, air-entrained concrete; 4000-psi minimum compressive strength; manufacturer's standard height and width by 72 inches long. Provide chamfered corners and a minimum of two factory-formed or -drilled vertical holes through wheel stop for anchoring to substrate.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. American Eagle Precast, LLC.
b. American Precast Concrete Inc.
c. Bush Concrete Products, Inc.
d. Cast-Crete USA, Inc.
e. Dura-Crete, Inc.

f. Oldcastle Infrastructure Inc.; CRH Americas.
g. Steps Plus, Inc.

2. Source Limitations: Obtain wheel stops from single source from single manufacturer.
3. Surface Appearance: Smooth, free of pockets, sand streaks, honeycombs, and other obvious defects. Corners shall be uniform, straight, and sharp.
4. Mounting Hardware: Galvanized-steel hardware as standard with wheel-stop manufacturer for mounting on concrete slab as indicated on Drawings.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that pavement is in suitable condition to begin installation in accordance with manufacturer's written instructions.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install wheel stops in accordance with manufacturer's written instructions unless otherwise indicated.

B. Securely anchor wheel stops to substrate with hardware in each preformed vertical hole in wheel stop as recommended in writing by manufacturer. Recess head of hardware beneath top of wheel stop.

END OF SECTION

SECTION 32 17 23 - PAVEMENT MARKINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Painted markings applied to asphalt paving.
2. Painted markings applied to concrete surfaces.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review methods and procedures related to marking asphalt paving or concrete surfaces including, but not limited to, the following:

    a. Asphalt-paving or concrete-surface aging period before application of pavement markings.
    b. Review requirements for protecting pavement markings, including restriction of traffic during installation period.

1.4 ACTION SUBMITTALS

A. Product Data: Include technical data and tested physical and performance properties.

1. Pavement-marking paint, acrylic.

B. Shop Drawings:

1. Indicate pavement markings, colors, lane separations, defined parking spaces, and dimensions to adjacent work.
2. Indicate, with international symbol of accessibility, spaces allocated for people with disabilities.

1.5 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with materials, workmanship, and other applicable requirements of Standards and Specifications of Maryland State Highway Administration for pavement-marking work.

1. Measurement and payment provisions and safety program submittals included in standard specifications do not apply to this Section.

1.6 FIELD CONDITIONS

A. Environmental Limitations: Proceed with pavement marking only on clean, dry surfaces and at a minimum ambient or surface temperature of 55 deg F for water-based materials, and not exceeding 95 deg F.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain pavement-marking paints from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Accessibility Standard: Comply with applicable provisions in the USDOJ's "2010 ADA Standards for Accessible Design".

2.3 PAVEMENT-MARKING PAINT

A. Pavement-Marking Paint, Acrylic: Acrylic, waterborne emulsion, lead and chromate free, ready mixed, complying with FS TT-P-1952F, Type II, with drying time of less than 45 minutes.

1. Color: As indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that pavement-marking substrate is dry and in suitable condition to begin pavement marking in accordance with manufacturer's written instructions.

B. Proceed with pavement marking only after unsatisfactory conditions have been corrected.

3.2 PAVEMENT MARKING

A. Do not apply pavement-marking paint until layout, colors, and placement have been verified with Architect.

B. Allow asphalt paving or concrete surfaces to age for a minimum of 30 days before starting pavement marking.

C. Sweep and clean surface to eliminate loose material and dust.

D. Apply paint with mechanical equipment to produce pavement markings, of dimensions indicated, with uniform, straight edges. Apply at manufacturer's recommended rates to provide a minimum wet film thickness of 15 mils.

1. Apply graphic symbols and lettering with paint-resistant, die-cut stencils, firmly secured to asphalt paving or concrete surface. Mask an extended area beyond edges of each stencil to prevent paint application beyond stencil. Apply paint so that it cannot run beneath stencil.

3.3 PROTECTING AND CLEANING

A. Protect pavement markings from damage and wear during remainder of construction period.

B. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION

This page is intentionally left blank.

SECTION 32 17 26 - TACTILE WARNING SURFACING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Detectable warning mats.

B. Related Requirements:

1. Section 321313 "Concrete Paving" for concrete walkways serving as substrates for tactile warning surfacing.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For tactile warning surfacing, to include in maintenance manuals.

1.5 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.6 PROJECT CONDITIONS

A. Cold-Weather Protection: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen subgrade or setting beds. Remove and replace unit paver work damaged by frost or freezing.

B. Weather Limitations for Adhesive Application:

1. Apply adhesive only when ambient temperature is above 50 deg F and when temperature has not been below 35 deg F for 12 hours immediately before application. Do not apply when substrate is wet or contains excess moisture.

C. Weather Limitations for Mortar and Grout:

1. Cold-Weather Requirements: Comply with cold-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.
2. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602. Provide artificial shade and windbreaks, and use cooled materials as required. Do not apply mortar to substrates with temperatures of 100 deg F and higher.

    a. When ambient temperature exceeds 100 deg F, or when wind velocity exceeds 8 mph and ambient temperature exceeds 90 deg F, set unit pavers within 1 minute of spreading setting-bed mortar.

1.7 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of tactile warning surfaces that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

    a. Deterioration of finishes beyond normal weathering and wear.
    b. Separation or delamination of materials and components.

2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 TACTILE WARNING SURFACING, GENERAL

A. Accessibility Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines for Buildings and Facilities for tactile warning surfaces.

1. For tactile warning surfaces composed of multiple units, provide units that when installed provide consistent side-to-side and end-to-end dome spacing that complies with requirements.

B. Source Limitations: Obtain each type of tactile warning surfacing, joint material, setting material, anchor, and fastener from single source with resources to provide materials and products of consistent quality in appearance and physical properties.

2.2 DETECTABLE WARNING MATS

A. Surface-Applied Detectable Warning Mats: Accessible truncated-dome detectable warning resilient mats, UV resistant, manufactured for adhering to existing concrete walkway surfaces, with slip-resistant surface treatment on domes, field of mat, and beveled outside edges.
1. Material: Modified rubber compound, UV resistant.
2. Color: As indicated by manufacturer's designations.
3. Shapes and Sizes:

    a. Rectangular panel, 24 by 48 inches.

4. Dome Spacing and Configuration: Manufacturer's standard compliant spacing in manufacturer's standard pattern.
5. Mounting: Adhered to pavement surface with adhesive and fastened with fasteners.

2.3 ACCESSORIES

A. Fasteners and Anchors: Manufacturer's standard as required for secure anchorage of tactile warning surfaces, noncorrosive and compatible with each material joined, and complying with the following:

1. Furnish Type 304 stainless-steel fasteners for exterior use.
2. Fastener Heads: For nonstructural connections, use flathead or oval countersunk screws and bolts with tamper-resistant heads, colored to match tile.

B. Adhesive: As recommended by manufacturer for adhering tactile warning surfacing unit to pavement.

C. Sealant: As recommended by manufacturer for sealing perimeter of tactile warning surfacing unit.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that pavement is in suitable condition to begin installation according to manufacturer's written instructions. Verify that installation of tactile warning surfacing will comply with accessibility requirements upon completion.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF TACTILE WARNING SURFACING

A. General: Prepare substrate and install tactile warning surfacing according to manufacturer's written instructions unless otherwise indicated.

B. Place tactile warning surfacing units in dimensions and orientation indicated. Comply with location requirements of AASHTO MP 12.

3.3 INSTALLATION OF DETECTABLE WARNING MATS

A. Lay out detectable warning mats as indicated and mark concrete pavement at edges of mats.

B. Prepare existing paving surface by grinding and cleaning as recommended by manufacturer.

C. Apply adhesive to back of mat in amounts and pattern recommended by manufacturer, and set mat in place. Firmly seat mat in adhesive bed, eliminating air pockets and establishing full adhesion to pavement. If necessary, temporarily apply weight to mat to ensure full contact with adhesive.

D. Install anchor devices through face of mat and into pavement using anchors located as recommended by manufacturer. Set heads of anchors flush with mat surface.

E. Mask mat perimeter and adjacent concrete, and apply sealant in continuous bead around perimeter of mat.

F. Remove masking, adhesive, excess sealant, and soil from exposed surfaces of detectable warning mat and surrounding concrete pavement using cleaning agents recommended in writing by manufacturer.

G. Protect installed mat from traffic until adhesive has set.

3.4 CLEANING AND PROTECTION

A. Remove and replace tactile warning surfacing that is broken or damaged or does not comply with requirements in this Section. Remove in complete sections from joint to joint unless otherwise approved by Architect. Replace using tactile warning surfacing installation methods acceptable to Architect.

B. Protect tactile warning surfacing from damage and maintain free of stains, discoloration, dirt, and other foreign material.

END OF SECTION

SECTION 32 31 19 - DECORATIVE METAL GATES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Swing gates.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For gates.

1. Include plans, elevations, sections, and mounting attachment details.
2. Indicate all hardware.

C. Samples: For each fence material and for each color specified.

1. Provide Samples 12 inches in length for linear materials.
2. Provide Samples 12 inches square for louver infill.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Design decorative metal gates including hinges to support self-weight in all positions and lateral wind loads based on the following:

1. Wind Exposure Category: As indicated on Drawings.
2. Design Wind Speed: As indicated on Drawings.

2.2 SWING GATES

A. Basis-of-Design Product: Subject to compliance with requirement, provide **PalmShield; Maximus Swing Gate** or comparable product.

B. Gate Configuration: As indicated.

C. Gate Frame Height: As indicated.

D. Gate Opening Width: As indicated.

E. Aluminum Gate Leaf Frames: Fabricate gate leaf frame from 4 by 2 inch rectangular extruded-aluminum tubes with 3 by 3 by 1/4 inch angle infill panel frame.

F. Frame Corner Construction: Welded.

G. Infill: Aluminum, 6 by 1 inch tubular tongue and groove slats secured in place by aluminum infill retaining angles; PalmShield EMS #41-63-729.

H. Hardware: Latches permitting operation from both sides of gate, hinges, and keepers for each gate leaf more than 5 feet wide. Provide center gate stops and cane bolts for pairs of gates.

I. Latch and Lock: Manufacturer's standard cipher lock with latch with handles permitting operation of gate from both sides of gate manufactured for exterior exposure.

J. Hinges: Industrial grade, heavy-duty barrel hinge with ball bearings and grease zert designed to support load of open gate without sagging; bolted to gate frame and field welded to steel gate post.

1. Basis-of-Design Product: Subject to compliance with requirement, provide **PalmShield; Gorilla Hinge** or comparable product.
2. Rod: 3/4 inch.
3. Hinge Plates: 1/2 inch thick offset to create a 5/8 inch gap.

K. Cane Bolts: Provide for inactive leaf of pairs of gates. Fabricated from 1-inch-diameter, round steel bar or pipe, hot-dip galvanized after fabrication. Finish to match gates. Provide galvanized-steel pipe strikes to receive cane bolts in closed position. Secure to gate from with 1/8 inch steel bracket with padlockable slide bolt.

L. Finish exposed welds to comply with NOMMA Guideline 1, Finish #2 - completely sanded joint, some undercutting and pinholes okay.

M. Aluminum Finish: Baked enamel or powder coating.

2.3 ALUMINUM

A. Aluminum, General: Provide alloys and tempers with not less than the strength and durability properties of alloy and temper designated in paragraphs below for each aluminum form required.

B. Extrusions: ASTM B221, Alloy 6063-T5.

C. Tubing: ASTM B429/B429M, Alloy 6063-T6.

D. Plate and Sheet: ASTM B209, Alloy 6061-T6.

E. Die and Hand Forgings: ASTM B247, Alloy 6061-T6.

F. Castings: ASTM B26/B26M, Alloy A356.0-T6.

2.4 ALUMINUM FINISHES

A. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of 2 mils. Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

1. Color and Gloss: As preselected and indicated in Finish Schedule.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for site clearing, earthwork, pavement work, construction layout, and other conditions affecting performance of the Work.

B. Do not begin installation before final grading is completed unless otherwise permitted by Architect.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 GATE INSTALLATION

A. Install gates according to manufacturer's written instructions, level, plumb, and secure for full opening without interference. Attach hardware using tamper-resistant or concealed means. Install ground-set items in concrete for anchorage. Adjust hardware for smooth operation and lubricate where necessary.

3.3 ADJUSTING

A. Gates: Adjust gates to operate smoothly, easily, and quietly, free of binding, warp, excessive deflection, distortion, nonalignment, misplacement, disruption, or malfunction, throughout entire operational range. Confirm that latches and locks engage accurately and securely without forcing or binding.

B. Lubricate hardware and other moving parts.

END OF SECTION

This page is intentionally left blank.

SECTION 32 91 15 - SOIL PREPARATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes planting soils and layered soil assemblies specified according to performance requirements of the mixes.

B. Related Requirements:

1. Division 31 Section “Earth Moving” for excavation, filling, and rough grading and for subsurface aggregate drainage and drainage backfill materials
2. Division 32 Section “Lawns & Turfgrasses" for turfgrass plantings.
3. Division 32 Section "Exterior Plants" for placing planting soil for plantings.

1.3 DEFINITIONS

A. AAPFCO: Association of American Plant Food Control Officials.

B. Backfill: The earth used to replace or the act of replacing earth in an excavation. This can be amended or unamended soil as indicated.

C. CEC: Cation exchange capacity.

D. Compost: The product resulting from the controlled biological decomposition of organic material that has been sanitized through the generation of heat and stabilized to the point that it is beneficial to plant growth.

E. Duff Layer: A surface layer of soil, typical of forested areas, that is composed of mostly decayed leaves, twigs, and detritus.

F. Imported Soil: Soil that is transported to Project site for use.

G. Layered Soil Assembly: A designed series of planting soils, layered on each other, that together produce an environment for plant growth.

H. Manufactured Soil: Soil produced by blending soils, sand, stabilized organic soil amendments, and other materials to produce planting soil.

I. NAPT: North American Proficiency Testing Program. An SSSA program to assist soil-, plant-, and water-testing laboratories through interlaboratory sample exchanges and statistical evaluation of analytical data.

J. Organic Matter: The total of organic materials in soil exclusive of undecayed plant and animal tissues, their partial decomposition products, and the soil biomass; also called "humus" or "soil organic matter."

K. Planting Soil: Existing, on-site soil; imported soil; or manufactured soil that has been modified as specified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth.

L. RCRA Metals: Hazardous metals identified by the EPA under the Resource Conservation and Recovery Act.

M. SSSA: Soil Science Society of America.

N. Subgrade: Surface or elevation of subsoil remaining after excavation is complete, or the top surface of a fill or backfill before planting soil is placed.

O. Subsoil: Soil beneath the level of subgrade; soil beneath the topsoil layers of a naturally occurring soil profile, typified by less than 1 percent organic matter and few soil organisms.

P. Surface Soil: Soil that is present at the top layer of the existing soil profile. In undisturbed areas, surface soil is typically called "topsoil"; but in disturbed areas such as urban environments, the surface soil can be subsoil.

Q. USCC: U.S. Composting Council.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include recommendations for application and use.
2. Include test data substantiating that products comply with requirements.
3. Include sieve analyses for aggregate materials.
4. Material Certificates: For each type of imported soil and soil amendment and fertilizer before delivery to the site, according to the following:

    a. Manufacturer's qualified testing agency's certified analysis of standard products.
    b. Analysis of fertilizers, by a qualified testing agency, made according to AAPFCO methods for testing and labeling and according to AAPFCO's SUIP #25.
    c. Analysis of nonstandard materials, by a qualified testing agency, made according to SSSA methods, where applicable.

B. Samples: For each bulk-supplied material, 1-quart (1-L) volume of each in sealed containers labeled with content, source, and date obtained. Each Sample shall be typical of the lot of material to be furnished; provide an accurate representation of composition, color, and texture.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For each testing agency.

B. Preconstruction Test Reports: For preconstruction soil analyses specified in "Preconstruction Testing" Article.

C. Field quality-control reports.

1.7 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent, state-operated, or university-operated laboratory; experienced in soil science, soil testing, and plant nutrition; with the experience and capability to conduct the testing indicated; and that specializes in types of tests to be performed.

1.8 PRECONSTRUCTION TESTING

A. Preconstruction Testing Service: Engage a qualified testing agency to perform preconstruction soil analyses on existing, on-site soil and imported soil.

1. Notify Landscape Architect seven days in advance of the dates and times when laboratory samples will be taken.

B. Preconstruction Soil Analyses: For each unamended soil type, perform testing on soil samples and furnish soil analysis and a written report containing soil-amendment and fertilizer recommendations by a qualified testing agency performing the testing according to "Soil-Sampling Requirements" and "Testing Requirements" articles.

1. Have testing agency identify and label samples and test reports according to sample collection and labeling requirements.

1.9 SOIL-SAMPLING REQUIREMENTS

A. General: Extract soil samples according to requirements in this article.

B. Sample Collection and Labeling: Have samples taken and labeled by Contractor a soil scientist (CPSS) certified by SSSA, soil scientist (RPSS) registered by the National Society of Consulting Soil Scientists or state-certified, -licensed, or -registered soil scientist under the direction of the testing agency.

1. Number and Location of Samples: Minimum of three representative soil samples from areas representing each of the nine soil conditions indicated on Drawings and where directed by Landscape Architect for each soil to be used or amended for landscaping purposes.

2. Procedures and Depth of Samples: According to USDA-NRCS's "Field Book for Describing and Sampling Soils"
3. Division of Samples: Split each sample into two, equal parts. Send half to the testing agency and half to Owner for their records.
4. Labeling: Label each sample with the date, location keyed to a site plan or other location system, visible soil condition, and sampling depth.

1.10 TESTING REQUIREMENTS

A. General: Perform tests on soil samples according to requirements in this article.

B. Physical Testing:

1. Soil Texture: Soil-particle, size-distribution analysis by one of the following methods according to SSSA's "Methods of Soil Analysis - Part 1-Physical and Mineralogical Methods":

   a. Sieving Method: Report sand-gradation percentages for very coarse, coarse, medium, fine, and very fine sand; and fragment-gradation (gravel) percentages for fine, medium, and coarse fragments; according to USDA sand and fragment sizes.
   b. Hydrometer Method: Report percentages of sand, silt, and clay.

2. Bulk Density: Analysis according to core method and clod method of SSSA's "Methods of Soil Analysis - Part 1-Physical and Mineralogical Methods."
3. Total Porosity: Calculate using particle density and bulk density according to SSSA's "Methods of Soil Analysis - Part 1-Physical and Mineralogical Methods."
4. Water Retention: According to SSSA's "Methods of Soil Analysis - Part 1-Physical and Mineralogical Methods."
5. Saturated Hydraulic Conductivity: According to SSSA's "Methods of Soil Analysis - Part 1-Physical and Mineralogical Methods"; at 85 percent compaction according to ASTM D698 (Standard Proctor).

C. Chemical Testing:

1. CEC: Analysis by sodium saturation at pH 7 according to SSSA's "Methods of Soil Analysis - Part 3- Chemical Methods."
2. Clay Mineralogy: Analysis and estimated percentage of expandable clay minerals using CEC by ammonium saturation at pH 7 according to SSSA's "Methods of Soil Analysis - Part 1-Physical and Mineralogical Methods."
3. Phytotoxicity: Test for plant-available concentrations of phytotoxic minerals including aluminum, arsenic, barium, cadmium, chlorides, chromium, cobalt, copper, lead, lithium, mercury, nickel, selenium, silver, sodium, strontium, tin, titanium, vanadium, and zinc.

D. Fertility Testing: Soil fertility analysis according to standard laboratory protocol of SSSA NAPT NEC-67 including the following:

1. Percentage of organic matter.
2. CEC, calcium percent of CEC, and magnesium percent of CEC.
3. Soil reaction (acidity/alkalinity pH value).
4. Buffered acidity or alkalinity.
5. Nitrogen ppm.
6. Phosphorous ppm.

7. Potassium ppm.
8. Manganese ppm.
9. Manganese-availability ppm.
10. Zinc ppm.
11. Zinc availability ppm.
12. Copper ppm.
13. Sodium ppm and sodium absorption ratio.
14. Soluble-salts ppm.
15. Presence and quantities of problem materials including salts and metals cited in the Standard protocol. If such problem materials are present, provide additional recommendations for corrective action.
16. Other deleterious materials, including their characteristics and content of each.

E. Organic-Matter Content: Analysis using loss-by-ignition method according to SSSA's "Methods of Soil Analysis - Part 3-Chemical Methods."

F. Recommendations: Based on the test results and designated plant material, state recommendations for soil treatments and soil amendments to be incorporated to produce satisfactory planting soil suitable for healthy, viable plants. Include, at a minimum, recommendations for nitrogen, phosphorous, and potassium fertilization, and for micronutrients.

1. Fertilizers and Soil Amendment Rates: State recommendations in weight per 1000 sq. ft. (100 sq. m) for each depth soil depth required.

G. Soil Reaction: State the recommended liming rates for raising pH or sulfur for lowering pH according to the buffered acidity or buffered alkalinity in weight per 1000 sq. ft. (100 sq. m) for each depth soil depth required.

1.11 DELIVERY, STORAGE, AND HANDLING

A. Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and compliance with state and Federal laws if applicable.

B. Bulk Materials:

1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.
2. Provide erosion-control measures to prevent erosion or displacement of bulk materials, discharge of soil-bearing water runoff, and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
3. Do not move or handle materials when they are wet or frozen.
4. Accompany each delivery of bulk fertilizers and soil amendments with appropriate certificates.

PART 2 - PRODUCTS

2.1 PLANTING SOILS SPECIFIED ACCORDING TO PERFORMANCE REQUIREMENTS

A. Base Soil: Testing and analysis are required to determine if existing on-site soil may be used as the base component for planting soil. Where quantity and quality of existing site soil is insufficient, soil imported from off-site locations that has been tested and approved shall be provided. The following Planting Soil Types describe the conditions required for suitable planting soil that incorporates either on-site surface soil or imported soil as the base component. At a minimum the base soil must meet the following criteria:

1. Base Soil shall be fertile, friable soil containing 15% or less of a total volume of the combination of subsoil, refuse, roots larger than 25mm (1-inch) diameter, clumps of heavy, sticky or stiff clay, stones larger than 75mm (3 inches) in diameter, noxious seeds, sticks, brush, litter, or any substances deleterious to plant growth. The percent (%) of the above objects shall be controlled by source selection, *not by screening the soil*. Base Soil shall be suitable for the germination of seeds and the support of vegetative growth. Base Soil shall not contain weed seeds in quantities that cause noticeable weed growth and hazardous weed species in the planting beds. The contractor shall remove all weeds as they emerge.

2. Particle Size Distribution by USDA Textures: Classified as sandy clay loam according to USDA textures and as follows:

   a. Clay: 20 – 32%
   b. Silt: 5-25%
   c. Sand: 50-70%

B. Amended Soil: Existing, suitable, on-site surface soil, with the duff layer, if any, retained; and stockpiled on-site; modified to produce viable planting soil for the conditions and intended plant material. Using preconstruction soil analyses and materials specified in other articles of this Section, amend existing, on-site surface soil to become planting soil complying with the following requirements:

1. Particle Size Distribution by USDA Textures: Classified as sandy loam according to USDA textures;
2. Additional requirements for Soil Chemical and Structural qualities shall be provided as part of final construction document issuance.

C. Imported Soil: Imported, naturally formed soil from off-site sources and consisting of sandy loam soil according to USDA textures; and modified to produce viable planting soil for the conditions and intended plant material. Amend imported soil with materials specified in other articles of this Section to become planting soil complying with the following requirements:

1. Sources: Take imported, unamended soil from sources that are naturally well-drained sites where topsoil occurs at least 4 inches (100 mm) deep, not from agricultural land, bogs, or marshes; and that do not contain undesirable organisms; disease-causing plant pathogens; or obnoxious weeds and invasive plants including, but not limited to, quackgrass, Johnsongrass, poison ivy, nutsedge, nimblewill, Canada thistle, bindweed, bentgrass, wild garlic, knotweed, mugwort, ground ivy, perennial sorrel, and bromegrass.

2. Additional Properties of Imported Soil before Amending: Minimum of 3-5 percent organic-matter content, friable, and with sufficient structure to give good tilth and aeration. Clean soil to be of the following:

    a. Unacceptable Materials: Concrete slurry, concrete layers or chunks, cement, plaster, building debris, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, acid, and other extraneous materials that are harmful to plant growth.
    b. Unsuitable Materials: Stones, roots, plants, sod, clay lumps, and pockets of coarse sand that exceed a combined maximum of 8 percent by dry weight of the imported soil.
    c. Large Materials: Stones, clods, roots, clay lumps, and pockets of coarse sand exceeding 3 inches (75 mm).

3. Additional requirements for Soil Chemical and Structural qualities shall be provided as part of final construction document issuance.

D. Planting-Soil Type 3: Manufactured soil consisting of manufacturer's basic sandy loam according to USDA textures blended in a manufacturing facility with sand, stabilized organic soil amendments, and other materials as specified in other articles of this Section to produce viable planting soil.

1. Basic Properties: Manufactured soil shall not contain the following:

    a. Unacceptable Materials: Concrete slurry, concrete layers or chunks, cement, plaster, building debris, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, acid, and other extraneous materials that are harmful to plant growth.
    b. Unsuitable Materials: Stones, roots, plants, sod, clay lumps, and pockets of coarse sand that exceed a combined maximum of 5 percent by dry weight of the manufactured soil.
    c. Large Materials: Stones, clods, roots, clay lumps, and pockets of coarse sand exceeding 2 inches (50 mm) in any dimension.

2.2 INORGANIC SOIL AMENDMENTS

A. Lime: ASTM C602, agricultural liming material containing a minimum of 80 percent calcium carbonate equivalent and as follows:

1. Class: O, with a minimum of 95 percent passing through No. 8 (2.36-mm) sieve and a minimum of 55 percent passing through a No. 60 (0.25-mm) sieve.
2. Form: Provide lime in the form of ground dolomitic limestone.

B. Sulfur: Granular, biodegradable, and containing a minimum of 90 percent elemental sulfur, with a minimum of 99 percent passing through a No. 6 (3.35-mm) sieve and a maximum of 10 percent passing through a No. 40 (0.425-mm) sieve.

C. Iron Sulfate: Granulated ferrous sulfate containing a minimum of 20 percent iron and 10 percent sulfur.

D. Agricultural Gypsum: Minimum 90 percent calcium sulfate, finely ground with 90 percent passing through a No. 50 (0.30-mm) sieve.

E. Sand: Clean, washed, natural or manufactured, free of toxic materials, and according to ASTM C33/C33M.

2.3 ORGANIC SOIL AMENDMENTS

A. Compost: Well-composted, stable, and certified weed-free organic matter produced by composting feedstock, and bearing USCC's "Seal of Testing Assurance," and as follows:

1. Feedstock: Limited to leaves.
2. Reaction: pH of 5.5 to 8.
3. Soluble-Salt Concentration: Less than 6 dS/m.
4. Moisture Content: 35 to 55 percent by weight.
5. Organic-Matter Content: less than 35 percent of dry weight.
6. Particle Size: Minimum of 98 percent passing through a 1/2-inch (13-mm) sieve.

B. Wood Derivatives: Shredded and composted, nitrogen-treated sawdust, ground bark, or wood waste; of uniform texture and free of chips, stones, sticks, soil, or toxic materials.

C. Manure: Well-rotted, unleached, stable or cattle manure containing not more than 25 percent by volume of straw, sawdust, or other bedding materials; certified free of toxic substances, stones, sticks, soil, weed seed, debris, and material harmful to plant growth.

2.4 FERTILIZERS

A. Superphosphate: Commercial, phosphate mixture, soluble; a minimum of 20 percent available phosphoric acid.

B. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of fast- and slow-release nitrogen, 50 percent derived from natural organic sources of urea formaldehyde, phosphorous, and potassium in the following composition:

1. Composition: 1 lb/1000 sq. ft. (0.5 kg/100 sq. m) of actual nitrogen, 4 percent phosphorous, and 2 percent potassium, by weight.
2. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified testing agency.

C. Slow-Release Fertilizer: Granular or pelleted fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium in the following composition:

1. Composition: 20 percent nitrogen, 10 percent phosphorous, and 10 percent potassium, by weight.
2. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified testing agency.

D. Chelated Iron: Commercial-grade FeEDDHA for dicots and woody plants, and commercial-grade FeDTPA for ornamental grasses and monocots.

PART 3 - EXECUTION

3.1 GENERAL

A. Place planting soil and fertilizers according to requirements in other Specification Sections.

B. Verify in writing that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in planting soil.

C. Proceed with placement only after unsatisfactory conditions have been corrected.

3.2 PREPARATION OF UNAMENDED, ON-SITE SOIL BEFORE AMENDING

A. Follow soil testing requirements and receive approval prior to using on-site soil as a component of any planting soil mix types.

B. Unacceptable Materials: Clean soil of concrete slurry, concrete layers or chunks, cement, plaster, building debris, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, acid, and other extraneous materials that are harmful to plant growth.

C. Unsuitable Materials: Clean soil to contain a combined maximum of 8 percent by dry weight of stones, roots, plants, sod, clay lumps, and pockets of coarse sand.

3.3 PLACING AND MIXING PLANTING SOIL OVER EXPOSED SUBGRADE

A. General: Apply and mix unamended soil with amendments on-site to produce required planting soil unless otherwise noted. Do not apply materials or till if existing soil or subgrade is frozen, muddy, or excessively wet.

B. Subgrade Preparation: Till subgrade to a minimum depth of 4 inches (100 mm). Remove stones larger than 1-1/2 inches (38 mm) in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner's property.

1. Apply, add soil amendments, and mix approximately half the thickness of unamended soil over prepared, loosened subgrade according to "Mixing" Paragraph below. Mix thoroughly into top 2 inches (50 mm) of subgrade. Spread remainder of planting soil.

C. Mixing: Spread unamended soil to total depth indicated on Drawings, but not less than required to meet finish grades after mixing with amendments and natural settlement. Do not spread if soil or subgrade is frozen, muddy, or excessively wet.

1. Amendments: Apply soil amendments, except compost, and fertilizer, if required, evenly on surface, and thoroughly blend them with unamended soil to produce planting soil.

a. Mix lime and sulfur, if required, with dry soil before mixing fertilizer.
b. Mix fertilizer with planting soil no more than seven days before planting.

2. Lifts: Apply and mix unamended soil and amendments in lifts not exceeding 8 inches (200 mm) in loose depth for material compacted by compaction equipment, and not more than 4 inches (100 mm) in loose depth for material compacted by hand-operated tampers.

D. Compaction: Compact each blended lift of planting soil to 80 to 85 percent of maximum Standard Proctor density according to ASTM D698 except where a different compaction value is indicated under DDOT or DC standards.

E. Finish Grading: Grade planting soil to a smooth, uniform surface plane with loose, uniformly fine texture. Roll and rake, remove ridges, and fill depressions to meet finish grades.

3.4 PLACING MANUFACTURED PLANTING SOIL OVER EXPOSED SUBGRADE

A. General: Apply manufactured soil on-site in its final, blended condition. Do not apply materials or till if existing soil or subgrade is frozen, muddy, or excessively wet.

B. Subgrade Preparation: Till subgrade to a minimum depth of 4 inches (100 mm). Remove stones larger than 1-1/2 inches (38 mm) in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner's property.

1. Apply approximately half the thickness of planting soil over prepared, loosened subgrade. Mix thoroughly into top 2 inches (50 mm) of subgrade. Spread remainder of planting soil.

C. Application: Spread planting soil to total depth indicated on Drawings but not less than required to meet finish grades after natural settlement. Do not spread if soil or subgrade is frozen, muddy, or excessively wet.

1. Lifts: Apply planting soil in lifts not exceeding 8 inches (200 mm) in loose depth for material compacted by compaction equipment, and not more than 4 inches (100 mm) in loose depth for material compacted by hand-operated tampers.

D. Compaction: Compact each lift of planting soil to 80 to 85 percent of maximum Standard Proctor density according to ASTM D698 except where a different compaction value is indicated by DDOT or DC standards.

E. Finish Grading: Grade planting soil to a smooth, uniform surface plane with loose, uniformly fine texture. Roll and rake, remove ridges, and fill depressions to meet finish grades.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Perform the following tests and inspections:

1. Compaction: Test planting-soil compaction after placing each lift and at completion using a densitometer or soil-compaction meter calibrated to a reference test value based on laboratory testing according to ASTM D698. Space tests at no less than one for each 1000 sq. ft. (100 sq. m) of in-place soil or part thereof.

2. Performance Testing: For each amended planting-soil type, demonstrating compliance with specified performance requirements.

    a. Perform testing according to "Soil-Sampling Requirements" and "Testing Requirements" articles.
    b. Perform tests before after amendments and before placement.
    c. Perform tests after placement.
    d. Perform tests with Landscape Architect present.

C. Soil will be considered defective if it does not pass tests and inspections. If planting soil or subgrade is over-compacted, disturbed, or contaminated by foreign or deleterious materials or liquids, remove the planting soil and contamination; restore the subgrade as directed by Landscape Architect and replace contaminated planting soil with new planting soil.

D. Prepare test and inspection reports.

E. Label each sample and test report with the date, location keyed to a site plan or other location system, visible conditions when and where sample was taken, and sampling depth.

3.6 PROTECTION

A. Protection Zone: Identify protection zones according to Section 015639 "Temporary Tree and Plant Protection."

B. Protect areas of in-place soil from additional compaction, disturbance, and contamination. Prohibit the following practices within these areas except as required to perform planting operations:

1. Storage of construction materials, debris, or excavated material.
2. Parking vehicles or equipment.
3. Vehicle traffic.
4. Foot traffic.
5. Erection of sheds or structures.
6. Impoundment of water.
7. Excavation or other digging unless otherwise indicated.

3.7 CLEANING

A. Protect areas adjacent to planting-soil preparation and placement areas from contamination. Keep adjacent paving and construction clean and the work area in an orderly condition.

B. Remove surplus soil and waste material including excess subsoil, unsuitable materials, trash, and debris and legally dispose of them off Owner's property unless otherwise indicated.

1. Dispose of excess subsoil and unsuitable materials on-site where directed by Owner.

END OF SECTION

This page is intentionally left blank.

SECTION 32 92 00 - LAWNS AND TURFGRASSES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Seeding.
2. Sodding.
3. Lawn renovation.

B. Related Sections include the following:

1. Division 31 Section "Site Clearing" for topsoil stripping and stockpiling.
2. Division 31 Section "Earth Moving" for excavation, filling and backfilling, and rough grading.
3. Division 32 Section "Soil Preparation" for soil preparation of areas to receive lawns and grasses.
4. Division 32 Section “Exterior Plants” for bed dividers and stormwater grasses.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Certification of Grass Seed: From seed vendor for each grass-seed monostand or mixture stating the botanical and common name and percentage by weight of each species and variety, and percentage of purity, germination, and weed seed. Include the year of production and date of packaging.

1. Certification of each seed mixture for turfgrass sod identifying source, including name and telephone number of suppliers.

C. Certification that the Maryland Department of Agriculture has inspected and certified turfgrass fields where sod is to be harvested. A “Maryland Certified Sod Label” must be attached to each delivery ticket of bill of lading in order for the sod to be certified.

D. Product Certificates: For soil amendments and fertilizers, signed by product manufacturer.

E. Qualification Data: For landscape Installer.

F. Material Test Reports:

1. Existing surface soil
2. Imported topsoil.

G. Planting Schedule: Indicating anticipated planting dates for each type of planting.

H. Maintenance Instructions: Recommended procedures to be established by Owner for maintenance of lawns during a calendar year. Submit before expiration of required maintenance periods.

1.3 QUALITY ASSURANCE

A. Installer Qualifications: A qualified landscape installer whose work has resulted in successful lawn establishment.

1. Installer's Field Supervision: Require Installer to maintain an experienced full-time English-speaking supervisor on Project site when planting is in progress.

B. Soil-Testing Laboratory Qualifications: An independent laboratory, recognized by the State Department of Agriculture, with the experience and capability to conduct the testing indicated and that specializes in types of tests to be performed.

C. Topsoil Analysis: Furnish soil analysis by a qualified soil-testing laboratory stating percentages of organic matter; gradation of sand, silt, and clay content; cation exchange capacity; sodium absorption ratio; deleterious material; pH; and mineral and plant-nutrient content of topsoil.

1. Report suitability of topsoil for lawn growth. State recommended quantities of nitrogen, phosphorus, and potash nutrients and soil amendments to be added to produce a satisfactory topsoil.

D. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination."

1.4 DELIVERY, STORAGE, AND HANDLING

A. Seed: Deliver seed in original sealed, labeled, and undamaged containers.

B. Sod: Harvest, deliver, store, and handle sod according to requirements in TPI's "Specifications for Turfgrass Sod Materials" and "Specifications for Turfgrass Sod Transplanting and Installation" in its "Guideline Specifications to Turfgrass Sodding."

1.5 SCHEDULING

A. Planting Restrictions: Plant during one of the following periods. Coordinate planting periods with maintenance periods to provide required maintenance from date of Substantial Completion.

1. Spring Planting: March 1 to June 15
2. Fall Planting: October 1 to December 1

B. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit.

1.6 LAWN MAINTENANCE

A. Begin maintenance immediately after each area is planted and continue until acceptable lawn is established, but for not less than the following periods:

1. Seeded Lawns: **60** days from date of Substantial Completion.

a. When full maintenance period has not elapsed before end of planting season, or if lawn is not fully established, continue maintenance during next planting season.

2. Sodded Lawns: 30 days from date of Substantial Completion.

B. Maintain and establish lawn by watering, fertilizing, weeding, mowing, trimming, replanting, and other operations. Roll, regrade, and replant bare or eroded areas and re-mulch to produce a uniformly smooth lawn.

1. In areas where mulch has been disturbed by wind or maintenance operations, add new mulch. Anchor as required to prevent displacement.

C. Watering: Provide and maintain temporary piping, hoses, and lawn-watering equipment to convey water from sources and to keep lawn uniformly moist to a depth of 4 inches (100 mm).

1. Schedule watering to prevent wilting, puddling, erosion, and displacement of seed or mulch. Lay out temporary watering system to avoid walking over muddy or newly planted areas.
2. Water lawn at a minimum rate of 1 inch (25 mm) per week.

D. Mow lawn as soon as top growth is tall enough to cut. Repeat mowing to maintain specified height without cutting more than 40 percent of grass height. Remove no more than 40 percent of grass-leaf growth in initial or subsequent mowings. Do not delay mowing until grass blades bend over and become matted. Do not mow when grass is wet. Schedule initial and subsequent mowings to maintain the following grass height:

1. Mow grass 2 to 3 inches (50 to 75 mm) high.

E. Lawn Postfertilization: Apply fertilizer after initial mowing and when grass is dry.

1. Use fertilizer that will provide actual nitrogen of at least 1 lb/1000 sq. ft. (0.45 kg/92.9 sq. m) to lawn area.

PART 2 - PRODUCTS

2.1 SEED

A. Grass Seed: Fresh, clean, dry, new-crop seed complying with AOSA's "Journal of Seed Technology; Rules for Testing Seeds" for purity and germination tolerances.

B. Seed Species: State-certified seed of grass species. Confirm species with the State of Maryland Department of Agriculture Turf Grass Recommended Variety List (Maryland-Turf-Grass-Variety-List.pdf)Seed Species: Seed of grass species as follows, with not less than **95** percent germination, not less than 95> percent pure seed, with no weed seed.

2.2 TURFGRASS SOD

A. Turfgrass Sod: Certified, including limitations on thatch, weeds, diseases, nematodes, and insects, complying with TPI's "Specifications for Turfgrass Sod Materials" in its "Guideline Specifications to Turfgrass Sodding." Furnish viable sod of uniform density, color, and texture, strongly rooted, and capable of vigorous growth and development when planted.

B. Confirm that sod provider has been inspected and certified as Maryland Certified Turfgrass. A “Maryland Certified Sod Label.” Must be attached to each delivery ticket or bill of lading in order

for the sod to be accepted as certified (mda.maryland.gov/plants-pests/Documents/Maryland-Certified-Sod-Directory.pdf)

C. Turfgrass Species: Sod of grass species as follows, with not less than **95** percent germination, not less than **85** percent pure seed, and not more than **0.5** percent weed seed:

1. Sun and Partial Shade: Proportioned by weight as follows:

a. 10% percent Kentucky bluegrass (Poa pratensis).

After Midnight	Endurance	Pivot
Aries	Fullback	Selway
Blue Bank	Hampton	Shannon
Blue Coat	Legend	Skye
Blue Note	Midnight	SPF 30
Bolt	Noble	

b. 90% percent tall fescue (Festuca rubra), minimum of three (3) varieties listed below:

Annapolis	Firecracker G-LS	Paramount	Supersonic
Avenger III	Firecracker SLS	Raptor LS	Symphony
Black Tail	Grande 3	Raptor III	Technique
Bullseye	GTO	Reflection	Temple
Catalyst	Guardian 41	Regenerate	Thor
Crossfire 4	Hemi	Rockwell	Titanium 2LS
Degas	Lifeguard	Screamer LS	Trinity
Dragster	Maestro	Standout	Valkyrie LS
Dynamite G-LS	Michelangelo	Spyder 2 LS	Wichita
Fayette	Moondance GLX	SR 8650	4th Millennium
Firebird 2			

2.3 PLANTING ACCESSORIES

A. Selective Herbicides: EPA registered and approved, of type recommended by manufacturer for application.

1. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing agency.

2.4 MULCHES

A. Straw Mulch: Provide air-dry, clean, mildew- and seed-free, salt hay or threshed straw of wheat, rye, oats, or barley.

B. Compost Mulch: Well-composted, stable, and weed-free organic matter, pH range of 5.5 to 8; moisture content 35 to 55 percent by weight; 100 percent passing through 1-inch (25-mm) sieve; soluble salt content of 5 to 10 decisiemens/m; not exceeding 0.5 percent inert contaminants and free of substances toxic to plantings; and as follows:

1. Organic Matter Content: **50 to 60** > percent of dry weight.
2. Feedstock: Agricultural, food, or industrial residuals; biosolids; yard trimmings; or source-separated or compostable mixed solid waste.

C. Fiber Mulch: Biodegradable, dyed-wood, cellulose-fiber mulch; nontoxic; free of plant-growth or germination inhibitors; with maximum moisture content of 15 percent and a pH range of 4.5 to 6.5.

D. Non-asphaltic Tackifier: Colloidal tackifier recommended by fiber-mulch manufacturer for slurry application; nontoxic and free of plant-growth or germination inhibitors.

2.5 EROSION-CONTROL MATERIALS

A. Erosion-Control Blankets: Biodegradable wood excelsior, straw, or coconut-fiber mat enclosed in a photodegradable plastic mesh. Include manufacturer's recommended steel wire staples, 6 inches (150 mm) long.

B. Erosion-Control Fiber Mesh: Biodegradable twisted jute or spun-coir mesh, a minimum of 0.92 lb/sq. yd. (0.5 kg/sq. m), with 50 to 65 percent open area. Include manufacturer's recommended steel wire staples, 6 inches (150 mm) long.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas to receive lawns and grass for compliance with requirements and other conditions affecting performance. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities, trees, shrubs, and plantings from damage caused by planting operations.

1. Protect adjacent and adjoining areas from hydroseeding overspray.

B. Provide erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

3.3 SOIL PREPARATION

A. Division 32 Section “Soil Preparation”.

3.4 SEEDING

A. Sow seed with spreader or seeding machine. Do not broadcast or drop seed when wind velocity exceeds 5 mph (8 km/h). Evenly distribute seed by sowing equal quantities in two directions at right angles to each other.

1. Do not use wet seed or seed that is moldy or otherwise damaged.

B. Sow seed at the rate of 5 to 8 lb/1000 sq. ft. (2.3 to 3.6 kg/92.9 sq.m).

C. Rake seed lightly into top 1/8 inch (3 mm) of topsoil, roll lightly, and water with fine spray.

D. Protect seeded areas with slopes exceeding 1:6 with erosion-control fiber mesh and 1:4 with erosion-control blankets installed and stapled according to manufacturer's written instructions.

E. Protect seeded areas with slopes not exceeding 1:6 by spreading straw mulch. Spread uniformly at a minimum rate of 2 tons/acre (42 kg/92.9 sq. m) to form a continuous blanket 1-1/2 inches (38 mm) in loose depth over seeded areas. Spread by hand, blower, or other suitable equipment.

1. Anchor straw mulch by crimping into topsoil with suitable mechanical equipment.
2. Bond straw mulch by spraying with asphalt emulsion at the rate of 10 to 13 gal./1000 sq. ft. (38 to 49 L/92.9 sq. m). Take precautions to prevent damage or staining of structures or other plantings adjacent to mulched areas. Immediately clean damaged or stained areas.

F. Protect seeded areas from hot, dry weather or drying winds by applying compost mulch within 24 hours after completing seeding operations. Soak and scatter uniformly to a depth of 3/16 inch (4.8 mm) and roll to a smooth surface.

3.5 HYDROSEEDING

A. Hydroseeding: Mix specified seed, fertilizer, and fiber mulch in water, using equipment specifically designed for hydroseed application. Continue mixing until uniformly blended into homogeneous slurry suitable for hydraulic application.

1. Mix slurry with non-asphaltic tackifier.
2. Apply slurry uniformly to all areas to be seeded in a one-step process. Apply mulch at a minimum rate of 1500-lb/acre (15.3-kg/92.9 sq. m) dry weight but not less than the rate required to obtain specified seed-sowing rate.
3. Apply slurry uniformly to all areas to be seeded in a two-step process. Apply first slurry application at a minimum rate of 500-lb/acre (5.1-kg/92.9 sq. m) dry weight but not less than the rate required to obtain specified seed-sowing rate. Apply slurry cover coat of fiber mulch at a rate of 1000 lb/acre (10.2 kg/92.9 sq. m).

3.6 SODDING

A. Lay sod within 24 hours of harvesting. Do not lay sod if dormant or if ground is frozen or muddy.

B. Remove netting prior to sod installation.

C. Lay sod to form a solid mass with tightly fitted joints. Butt ends and sides of sod; do not stretch or overlap. Stagger sod strips or pads to offset joints in adjacent courses. Avoid damage to subgrade or sod during installation. Tamp and roll lightly to ensure contact with subgrade, eliminate air pockets, and form a smooth surface. Work sifted soil or fine sand into minor cracks between pieces of sod; remove excess to avoid smothering sod and adjacent grass.

1. Lay sod across angle of slopes exceeding 1:3.
2. Anchor sod on slopes exceeding 1:6 with wood pegs or steel staples spaced as recommended by sod manufacturer but not less than 2 anchors per sod strip to prevent slippage.

D. Saturate sod with fine water spray within two hours of planting. During first week, water daily or more frequently as necessary to maintain moist soil to a minimum depth of 1-1/2 inches (38 mm) below sod.

3.7 LAWN RENOVATION

A. Renovate existing lawn.

B. Renovate existing lawn damaged by Contractor's operations, such as storage of materials or equipment and movement of vehicles.

1. Reestablish lawn where settlement or washouts occur or where minor regrading is required.

C. Remove sod and vegetation from diseased or unsatisfactory lawn areas; do not bury in soil.

D. Remove topsoil containing foreign materials resulting from Contractor's operations, including oil drippings, fuel spills, stone, gravel, and other construction materials, and replace with new topsoil.

E. Mow, dethatch, core aerate, and rake existing lawn.

F. Remove weeds before seeding. Where weeds are extensive, apply selective herbicides as required. Do not use pre-emergence herbicides.

G. Remove waste and foreign materials, including weeds, soil cores, grass, vegetation, and turf, and legally dispose of them off Owner's property.

H. Till stripped, bare, and compacted areas thoroughly to a soil depth of 6 inches (150 mm).

I. Apply soil amendments and initial fertilizers required for establishing new lawns and mix thoroughly into top 4 inches (100 mm) of existing soil. Provide new planting soil to fill low spots and meet finish grades.

J. Apply seed and protect with straw mulch as required for new lawns.

K. Water newly planted areas and keep moist until new lawn is established.

3.8 SATISFACTORY LAWNS

A. Satisfactory Seeded Lawn: At end of maintenance period, a healthy, uniform, close stand of grass has been established, free of weeds and surface irregularities, with coverage exceeding 90 percent over any 10 sq. ft. (0.92 sq. m) and bare spots not exceeding 3 by 3 inches (76 by 76 mm).

B. Reestablish lawns that do not comply with requirements and continue maintenance until lawns are satisfactory.

3.9 CLEANUP AND PROTECTION

A. Promptly remove soil and debris created by lawn work from paved areas. Clean wheels of vehicles before leaving site to avoid tracking soil onto roads, walks, or other paved areas.

B. Erect barricades and warning signs as required to protect newly planted areas from traffic. Maintain barricades throughout maintenance period and remove after lawn is established.

C. Remove erosion-control measures after grass establishment period.

END OF SECTION

SECTION 32 93 00 - EXTERIOR PLANTS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Trees.
2. Shrubs.
3. Grasses
4. Perennials.
5. Planting Accessories.
6. Edgings.
7. Mulch.
8. Maintenance and Warranty of Exterior Plants.

B. Related Sections include the following:

1. Division 31 Section "Site Clearing" for topsoil stripping and stockpiling, and site clearing.
2. Division 01 Section “Tree Protection and Trimming”.
3. Division 31 Section "Earth Moving" for excavation, filling, and rough grading and for subsurface aggregate drainage and drainage backfill materials.
4. Division 32 Section “Planting Soil Preparation”
5. Division 32 Section “Lawns and Turfgrasses” for turfgrass plantings.

1.2 DEFINITIONS

A. Balled and Burlapped Stock: Exterior plants dug with firm, natural balls of earth in which they are grown, with ball size not less than [diameter and depth recommended by ANSI Z60.1 for type and size of tree or shrub required; wrapped, tied, rigidly supported, and drum-laced as recommended by ANSI Z60.1.

B. Container-Grown Stock: Healthy, vigorous, well-rooted exterior plants grown in a container with well-established root system reaching sides of container and maintaining a firm ball when removed from container. Container shall be rigid enough to hold ball shape and protect root mass during shipping and be sized according to ANSI Z60.1 for kind, type, and size of exterior plant required.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Samples for Verification: For each of the following:

1. Edging materials and accessories, of manufacturer's standard size, to verify color selected.

C. Product Certificates: For each type of manufactured product, signed by product manufacturer, and complying with the following:

1. Manufacturer's certified analysis for standard products.
2. Analysis of other materials by a recognized laboratory made according to methods established by the Association of Official Analytical Chemists, where applicable.

D. Qualification Data: For landscape Installer.

E. Planting Schedule: Indicating anticipated planting dates for exterior plants.

F. Photographs: Submit photographs of plants, as requested by the Landscape Architect, prior to Observation, as listed under Quality Assurance, below. Photographs shall include a person holding a clearly-marked measuring rod next to plants. Photographs shall exhibit the size, growth habit, and general visual quality of plants. Photographs of dense clusters of plants, in which one plant is not distinguishable from another, are not acceptable. Digital photographs submitted via email are acceptable.

G. Maintenance Instructions: Recommended procedures to be established by Owner for maintenance of exterior plants, including material in the Bioretention areas, during a calendar year. Submit before expiration of required maintenance periods.

1.4 QUALITY ASSURANCE

A. Nursery Certifications:

1. Indicate on nursery letterhead the name of plants in accordance with the ITIS (Integrated Taxonomic Information System): https://www.itis.gov or Catalogue of Life: http://www.catalogueoflife.org including botanical common names, quantity, and size.
2. Plants shall be selected for licensed nurseries.

B. Installer Qualifications: A qualified landscape installer, licensed to work in the State of Maryland, whose work has resulted in successful establishment of exterior plants in landscapes of similar scope to that required for the work, including the handling and planting of large trees.

1. Submit copy of license and three references for similar work completed in the last five years.
2. Installer's Field Supervision: Require Installer to maintain an experienced full-time, English-speaking, supervisor on Project site at all times when exterior planting and regular maintenance is in progress. Supervisor should have a minimum of five years' experience as a field supervisor installing plants and trees of the quality and scale of the project.

C. Provide quality, size, genus, species, and variety of exterior plants indicated, complying with applicable requirements in ANSI Z60.1, "American Standard for Nursery Stock." Provide Plant Lists stating total number of each plant three months before expected planting date for compliance wit planting plan and list.

1. Substitutions of plants will not be permitted unless authorized in writing by the Landscape Architect, prior to purchase for this Project. Contractor shall make every reasonable effort to find the material specified and is responsible for documenting any plant suitability or availability problems with the above Plant List. If after extensive searching, plant is not

available and cannot be contract grown, contractor shall detail the search that has been made and offer Plant Substitutions.

D. Tree and Shrub Measurements: Measure according to ANSI Z60.1 with branches and trunks or canes in their normal position. Do not prune to obtain required sizes. Take caliper measurements 6 inches (150 mm) above ground for trees up to 4-inch (100-mm) caliper size, and 12 inches (300 mm) above ground for larger sizes. Measure main body of tree or shrub for height and spread; do not measure branches or roots tip-to-tip.

E. Approvals and Observation:

1. Contractor shall submit a list of plant sources for all plant materials for Landscape Architect's approval. Contractor shall also work with the representative from the Department of General Services and Landscape Architect to schedule trips to the sources designated by the Contracting Officer to inspect and approve the plant materials at the nurseries, and tag approved materials, prior to ordering and delivery to the project site.
2. A representative from the Department of General Services and the Landscape Architect will observe trees and shrubs either at place of growth or at site before planting for compliance with requirements for genus, species, variety, size, and quality. Department of General Services representative and Landscape Architect retain the right to observe trees and shrubs further for size and condition of balls and root systems, insects, injuries, and latent defects and to reject unsatisfactory or defective material at any time during progress of work. Remove rejected trees or shrubs immediately from Project site.

    a. Notify the Department of General Services representative and the Landscape Architect of sources of planting materials seven days in advance of delivery to site.

3. For plants the representative from the Department of General Services and Landscape Architect chooses not to inspect at the source, Contractor shall submit nursery photographs, Landscape Architect approval prior to ordering. Photographs shall include the tree root flare and trunk, taken from a minimum of two sides of trees, photographs for shrubs shall show the side and the top. It is acceptable to show multiple plants in a photograph if all sides are visible. An object, preferably a nursery measuring pole, yardstick, or person will be in each photograph to use as a size reference.
4. All selected plants shall be inspected upon delivery to the project site by the representative from the Department of General Services and Landscape Architect. Plants will be inspected once they are unloaded from the delivery vehicle. Contractor shall notify the representative from the Department of General Services and Landscape Architect two (2) weeks in advance of all plant deliveries to coordinate inspection upon delivery.

F. Plant Substitutions for Plants Not Available

1. Submit all requests for plant substitutions or size changes to the Landscape Architect for approval prior to purchasing the proposed substitution and at least 30 days prior to installation dates. Contractor shall provide list of sources for all plant material and procurement status 60 days in advance of tentative planting schedule. Landscape Architecture shall sign off on plant substitutions prior to contractor planning, designing, purchasing, and planting any substitutions.

    a. Request for substitutions shall be accompanied with a list of nurseries contacted in the search for the required plant and a record of other attempts to locate the desired plants.

b. Substitutions will only be allowed when the contractor has demonstrated that all efforts to procure the specified plant, cultivar or size have been exhausted. Landscape Architect will determine the plant substitutions.

G. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination."

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver with branches tied and exposed branches covered with material which allows air circulation. Prevent damage to branches, trunks, root systems, and root balls and desiccation of leaves. Plants shall arrive in acceptable condition.

B. Deliver plants with durable waterproof labels in weather-resistant ink. Provide labels stating the correct botanical and common plant name and variety as applicable and size as specified in the list of required plants. Attach to plants, bundles, and containers of plants. Groups of plants may be labeled by tagging one plant. Labels shall be legible for a minimum of 60 days after delivery to the planting site.

C. Store, irrigate, maintain, and otherwise protect balled and burlapped trees in a manner that prevents mechanical injury and physiological stress between the time of digging and delivery.

D. Deliver exterior plants freshly dug.

1. Immediately after digging up bare-root stock, pack root system in wet straw, hay, or other suitable material to keep root system moist until planting.

E. Do not prune trees and shrubs before delivery, except as approved by Landscape Architect. Protect bark, branches, and root systems from sun scald, drying, sweating, whipping, and other handling and tying damage. Do not bend or bind-tie trees or shrubs in such a manner as to destroy their natural shape. Irrigate balled and burlapped plants thoroughly immediately prior to transport. Provide protective covering of exterior plants during delivery. Do not drop exterior plants during delivery.

F. Handle planting stock by root ball. Planting stock with cracked or broken root balls will not be accepted.

G. Deliver exterior plants after preparations for planting have been completed and install immediately. If planting is delayed more than six hours after delivery, set exterior plants trees in shade, protect from weather and mechanical damage, and keep roots moist.

1. Set balled stock on ground and cover ball with woodchip mulch or other acceptable material.
2. Do not remove container-grown stock from containers before time of planting.
3. Water root systems of exterior plants stored on-site with a fine-mist spray. Water as often as necessary to maintain root systems in a moist condition.

1.6 COORDINATION

A. Contractor is responsible for determining plant quantities per planting plan. Contractor is responsible for filling all areas on plans shown to be planted on planting plan. Contractor shall

prepare his or her own quantity list from the plans. All grasses and perennials, for stormwater planting are to be filled at the specified spacing.

B. Planting Restrictions: Plant during one of the following periods. Coordinate planting periods with maintenance periods to provide required maintenance from date of Substantial Completion.

1. Spring Planting: March 15 to June 15

a. Deciduous material
b. Herbaceous material

2. Fall Planting: September 15 to October 31

a. Evergreen material
b. Deciduous material
c. Herbaceous material

3. No Planting shall occur between June 15 and September 14, inclusive, except as authorized by the Landscape Architect.

C. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit.

D. Coordination with Other Work: Coordinate planting with all other work of the project, including the following:

1. Landscape Irrigation: Coordinate planting with location of irrigation equipment. Coordinate aiming of landscape irrigation equipment to ensure that plantings do not impair the irrigation system from functioning as designed. Ensure that plant locations do not block irrigation spray and do not interfere with other irrigation equipment, including moisture sensors and rain sensors.
2. Site Lighting and Electrical Equipment: Coordinate planting with site lighting to ensure that plantings do not impair site lighting from illuminating the site as designed. Following planting installation, coordinate aiming of site lighting that is intended to illuminate plants.

E. Coordination with Lawns: Plant trees and shrubs after finish grades are established and before planting lawns, unless otherwise acceptable to Landscape Architect.

1. When planting trees and shrubs after lawns, protect lawn areas and promptly repair damage caused by planting operations.

1.7 WARRANTY

A. Special Warranty: Warrant all exterior plants covered by this Section, for the warranty period indicated, against defects including death and unsatisfactory growth, except for defects resulting from lack of adequate maintenance, neglect, or abuse by Owner, or incidents that are beyond Contractor's control.

1. Warranty Period for Exterior Plants:

a. From date of Installation to Substantial Completion.
b. Two years from date of Substantial Completion.

2. Remove dead exterior plants immediately. Replace immediately unless outside of approved planting seasons, in which case Landscape Architect will determine whether material is required to be planted immediately or in the succeeding planting season.
3. Replace without cost to Owner, as soon as weather and soil conditions permit, exterior plants that are more than 25 percent dead or in an unhealthy condition as determined solely by the Landscape Architect at end of the two-year warranty period.

1.8 MAINTENANCE

A. Maintenance Period for all exterior plants covered by this Section: Concurrent with Warranty Period and same duration as Warranty Period. Maintenance requirements are itemized in Part 3 of this Section.

B. Owner will assume maintenance following completion of Maintenance Period.

PART 2 - PRODUCTS

2.1 TREE AND SHRUB MATERIAL

A. General: Furnish nursery-grown trees and shrubs in accordance with good horticultural practices under climatic conditions similar to those of the Project for at least two years, unless specifically noted otherwise. Trees and shrubs shall comply with ANSI Z60.1, with healthy root systems developed by transplanting or root pruning. Trees and shrubs shall exceed AAN standards for quality by being exceptionally heavy, uniform, so trained or favored in development and appearance as to be superior in form, density and spread of branches, compactness, and symmetry. Determination of quality shall be made by the Landscape Architect. Provide well-shaped, fully branched, healthy, vigorous stock free of disease, insects, eggs, larvae, and defects such as knots, sun scald, leaf spotting, injuries, abrasions, and disfigurement.

B. Root Ball Size: Rootballs shall conform to ANSI/ANLA Z60.1. All wrappings and ties shall be biodegradable. Root bound plants will not be accepted.

C. Trees shall be planted such that the root flare is 1" above adjacent grade, unless the drawings indicate otherwise. Tree planting height shall be dictated by the actual root flare rather than the top of rootball as received from growers or nurseries.

1. Tops of tree rootballs shall be no higher than 2" above the tops of main order tree roots.
2. If main order roots are buried greater than 2" but less than 4" below the top of tree rootballs, contractor must trim rootballs by carefully removing soil from the top of the rootballs so that main order roots are within 2" of the top of rootball.
3. If main order roots are buried greater than 4" below the top of rootball, the tree will be rejected, and the contractor must remove the tree from the jobsite.
4. The contractor is responsible for ensuring that trees received on site and planted on site meet the aforementioned specifications regarding tree root flare and rootball. The contractor is responsible for ensuring that the landscape architect has an opportunity to review the tree root flares of trees in the growers' field or nursery yard. If tree root flares are obscured (due to trunk wrap or burlap or other obstructions), landscape architect's acceptance of trees in the grower's yard or nursery shall constitute acceptance of trees WITH THE EXCEPTION of trees whose root flare is buried greater than 4" below top of rootball. In the event that contractor does not allow Landscape Architect to visually

observe tree root flares during tree selection at grower's yard or nursery, Landscape Architect reserves the right to reject any tree delivered to the site if tree's root flare is buried greater than 4" below top of rootball, even if Landscape Architect previously accepted said trees at the grower's yard or nursery.

D. Primary structural roots shall be visibly numerous, well-distributed, and radiating straight away from the trunk.

E. Grade: Provide trees and shrubs of sizes and grades complying with ANSI Z60.1 for type of trees and shrubs required. Trees and shrubs of a larger size may be used if acceptable to Landscape Architect, with a proportionate increase in size of roots or balls.

F. Label each tree and shrub with securely attached waterproof tag bearing legible designation of botanical and common name.

G. If formal arrangements or consecutive order of trees or shrubs is shown, select stock for uniform height, branching height, and spread, and number label to assure symmetry in planting.

2.2 SHADE AND FLOWERING TREES

A. Deciduous Trees: A height to caliper relationship shall be provided in accordance with ANSI/ANLA Z60.1. Height of branching shall bear a relationship to the size and species of tree specified and with the crown in good balance with the trunk.

1. Single stem: The trunk shall be reasonably straight and symmetrical with crown and have a persistent main leader.
2. Multi-stem and Clump: All countable stems, in aggregate, shall average the size specified. To be considered a stem, there shall be no division of the trunk which branches more than 6 inches from ground level. Multi-stem and clump trees shall meet height as specified, measured with a pole from the base of the plant to the top of the height growth.

B. Shade Trees: Single-stem trees with straight trunk, well-balanced crown, and intact leader, of height and caliper indicated, complying with ANSI Z60.1 for type of trees required. Trees should be symmetrically developed and of uniform habit of growth, with straight boles or stems and free from objectionable disfigurements.

1. Provide balled and burlapped trees.
2. Branching Height: One-third to one-half of tree height. For street trees branching height shall be one half of tree height.

C. Small Upright or Spreading Trees: Branched or pruned naturally according to species and type, with relationship of caliper, height, and branching according to ANSI Z60.1; stem form as follows:

1. Stem Form: As indicated.
2. Provide balled and burlapped trees.

D. Multi-stem Trees: Branched or pruned naturally according to species and type, with relationship of caliper, height, and branching according to ANSI Z60.1; stem form as follows:

1. Stem Form: Clump.
2. Provide balled and burlapped trees.

2.3 DECIDUOUS SHRUBS

A. Form and Size: Deciduous shrubs with not less than the minimum number of canes required by and measured according to ANSI Z60.1 for type, shape, and height of shrub. Acceptable plant material shall be well shaped, with sufficient well-spaced side branches, and recognized by the trade as typical for the species grown in the region of the project.

1. Provide container-grown or fabric bag-grown shrubs.

2.4 GROUND COVER PLANTS

A. Ground Cover: Provide ground cover of species indicated, established and well rooted in pots or similar containers, and complying with ANSI Z60.1 and the following requirements:

2.5 PLANTS

A. Perennials: Provide vigorous, healthy, field-grown plants from a certified, commercial nursery, of species and variety shown or listed. Plants should be free from insects and disease; not overgrown (leggy). Plants that have been recently potted up to the next size container will be counted as the previous container size.

2.6 PLANTING SOIL

A. Division 2 Section “Soil Preparation”.

2.7 MULCHES

A. Organic Mulch: Free from deleterious materials and suitable as a top dressing of trees and shrubs, consisting of one of the following:

1. Type: Shredded hardwood, Ground or shredded bark, or Wood and bark chips.
2. The use of mulch shall be limited to a maximum total depth no greater than 2 inches and applied only where existing mulch has either been cultivated into the soil or removed. Organic mulch shall be double shredded hardwood mulch, Virginia Pine Fines, or Leaf Compost. Avoid using fresh wood chips, hardwood bark, saw dust or shavings, and pine bark containing a high percentage of white sap wood because these materials will compete with plants for nitrogen. Repeated use of hardwood mulches infuses the soil with toxic levels of manganese. No colored or dyed mulches shall be used.
3. Special care shall be taken in the mulching operation not to over mulch or cover the base trunk of trees, shrubs, and crowns of perennials with mulch.

2.8 STAKES AND GUYS

A. Install Stakes and Guys per methods and locations as shown on the Drawings.

B. Upright and Guy Stakes: Rough-sawn, sound, new hardwood, redwood, or pressure-preservative-treated softwood, free of knots, holes, cross grain, and other defects, 2 by 2 inches (50 by 50 mm) by length indicated, pointed at one end.

C. Guy Ties and Guards:

1. Guy and Tie Wire: ASTM A 641/A 641M, Class 1, galvanized-steel wire, 2-strand, twisted, 0.106 inch (2.7 mm) in diameter.
2. Guy Cable: For large trees: 5-strand, 3/16-inch- (4.8-mm-) diameter, galvanized-steel cable, with zinc-coated turnbuckles, a minimum of 3 inches (75 mm) long, with two 3/8-inch (10-mm) galvanized eyebolts.
3. Hose Chafing Guard: Reinforced rubber or plastic hose at least 1/2 inch (13 mm) in diameter, black, cut to lengths required to protect tree trunks from damage.
4. Woven Fabric Guy Ties: Flat, woven, non-fraying, polypropylene material, ¾" wide, white. Arbor Tie or approved equivalent.

D. Guy and Anchoring System: ArborGuy 40E (www.stakingsystems.com), or approved equivalent. ArborGuy guylines, arrowhead anchors, tool-free tensioners.

E. Flags: Standard surveyor's plastic flagging tape, white, 6 inches (150 mm) long.

2.9 LANDSCAPE EDGINGS

A. Steel Edging: Standard commercial-steel edging, rolled edge, fabricated in sections of standard lengths, with loops stamped from or welded to face of sections to receive stakes.

1. Edging Size: 1/8 inch (3.2 mm) wide by 6 inches (150 mm) deep.
2. Stakes: Tapered steel, a minimum of 12 inches (300 mm) long.
3. Accessories: Standard tapered ends, corners, and splicers.
4. Finish: Standard paint.
5. Paint Color: Black.

2.10 MISCELLANEOUS PRODUCTS

A. Antidesiccant: Water-insoluble emulsion, permeable moisture retarder, film forming, for trees and shrubs, designed to permit transpiration but retard excessive loss of moisture from plants. Deliver in original, sealed, and fully labeled containers and mix according to manufacturer's written instructions.

1. Dowax by Dow Chemical Co., or Wilt-Proof by Nursery Specialty Products, Inc.

B. Tree Watering Bags: UV-treated polyethylene irrigation bag reinforced with nylon webbing. All sides to be watertight with ¼" thick heat seals. Bags shall have nylon zippers to allow to be secured to tree or secured to other bags for multiple-bag configuration.

1. Manufacturer: TreeGator, 1-866-873-3428, or approved equivalent.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas to receive exterior plants for compliance with requirements and conditions affecting installation and performance. Notify Landscape Architect, in writing, of any conditions

that might prevent satisfactory completion. Proceed with installation only after unsatisfactory conditions have been corrected.

B. Test drainage of pits and planting beds. Notify Landscape Architect of potential poor drainage of tree and shrub pits and planting beds. Recommend a program for correction of poor drainage conditions and submit proposal to Landscape Architect. Do not proceed with planting operations in areas of poor drainage until conditions are corrected, or direction is given by the Landscape Architect.

3.2 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities, and lawns and existing exterior plants from damage caused by planting operations.

B. Provide erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

C. Lay out individual tree and shrub locations and areas for multiple exterior plantings. Stake locations, outline areas, adjust locations when requested, and obtain Landscape Architect's acceptance of layout before planting. Make minor adjustments as required.

D. Lay out exterior plants at locations directed by Landscape Architect. Stake locations of individual trees and shrubs and outline areas for multiple plantings.

E. Apply antidesiccant to trees and shrubs using power spray to provide an adequate film over trunks, branches, stems, twigs, and foliage to protect during digging, handling, and transportation.

1. If deciduous trees or shrubs are moved in full leaf, spray with antidesiccant at nursery before moving and again two weeks after planting.

3.3 PLANTING BED ESTABLISHMENT

A. Division 32 Section “Soil Preparation”.

3.4 TREE AND SHRUB EXCAVATION

A. Division 32 Section “Soil Preparation”.

3.5 TREE AND SHRUB PLANTING

A. Set balled and burlapped stock plumb and in center of pit or trench with root flare 1 inch (25 mm) above adjacent finish grades.

1. Cut burlap and wire baskets from top half of root balls, but do not remove from under root balls. Discard removed burlap and wire baskets; do not turn down baskets and leave in tree or shrub pits. Remove pallets, if any, before setting. Do not use planting stock if root ball is cracked or broken before or during planting operation.
2. Place planting soil mix around root ball in layers, tamping to settle mix and eliminate voids and air pockets. When pit is approximately one-half backfilled, install transplant

inoculants per manufacturer's directions and water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed. Water again after placing and tamping final layer of planting soil mix.

3. Prepare surface of planting bed as shown on drawings.

B. Set container-grown stock plumb and in center of pit or trench with root flare 1 inch (25 mm) above adjacent finish grades.

1. Carefully remove root ball from container without damaging root ball or plant.
2. Make four (4) evenly spaced vertical cuts in the sides of the root ball with a clean, sharp utility knife. Cuts are to be one inch (1") deep and are to extend the full height of the rootball.
3. Place planting soil mix around root ball in layers, tamping to settle mix and eliminate voids and air pockets. When pit is approximately one-half backfilled, install transplant inoculants per manufacturer's directions and water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed. Water again after placing and tamping final layer of planting soil mix.
4. Prepare surface of planting bed as shown on drawings.

C. Organic Mulching: Apply 2-inch (50-mm) average thickness of organic mulch extending 12 inches (300 mm) beyond edge of planting pit or trench. Do not place mulch within 3 inches (75 mm) of trunks or stems.

D. Wrap trees of 2-inch (50-mm) caliper and larger with trunk-wrap tape if requested by Landscape Architect. Start at base of trunk and spiral cover trunk to height of first branches. Overlap wrap, exposing half the width, and securely attach without causing girdling. Inspect tree trunks for injury, improper pruning, and insect infestation; take corrective measures required before wrapping.

3.6 TREE AND SHRUB PRUNING

A. Prune, thin, and shape trees and shrubs as directed by Landscape Architect.

B. Prune, thin, and shape trees and shrubs according to standard horticultural practice. Prune trees to retain required height and spread. Unless otherwise indicated by Landscape Architect, do not cut tree leaders; remove only injured or dead branches from flowering trees. Prune shrubs to retain natural character. Shrub sizes indicated are sizes after pruning.

3.7 GUYING AND STAKING

A. Guy and Stake trees as indicated on the drawings. Installation of tree support systems shall be completed within 48 hours of planting, utilizing applicable methods as indicated.

3.8 PERENNIAL PLANTING

A. Set out and space perennials as indicated.

B. Dig holes large enough to allow spreading of roots and backfill with planting soil.

C. Work soil around roots to eliminate air pockets and leave a slight saucer indentation around plants to hold water.

D. Water thoroughly after planting, taking care not to cover plant crowns with wet soil.

E. Protect plants from hot sun and wind; remove protection if plants show evidence of recovery from transplanting shock.

3.9 PLANTING BED MULCHING

A. Mulch backfilled surfaces of planting beds and other areas indicated.

1. Organic Mulch: Apply 2-inch (50-mm) average thickness of organic mulch, and finish level with adjacent finish grades. Do not place mulch against plant stems.

3.10 EDGING INSTALLATION

A. Steel Edging: Install steel edging where indicated according to manufacturer's written instructions. Anchor with steel stakes spaced approximately 30 inches (760 mm) apart, driven below top elevation of edging.

3.11 TREE WATERING BAGS

A. Install a minimum of one tree watering bag per tree. Install multiple bags for trees as recommended by the tree watering bag manufacturer. Fill water bags for each tree.

3.12 INITIAL ACCEPTANCE

A. When all work except maintenance and guarantee program of this contract has been completed, Landscape Architect will perform a Substantial Completion inspection. Provide notification at least ten (10) working days before inspection date.

1. If required a “punch list” of items to be completed by an agreed upon date will be issued by the Landscape Architect after the Substantial Completion inspection.

B. Work will be considered Substantially Complete after all “punch list” items are complete. Notify the Landscape Architect at least five (5) working days before re-inspection date, to verify completion of the “punch list” items.

C. Substantial Completion certificate will be issued and dated by the Landscape Architect following the “punch list” verification inspection.

3.13 MAINTENANCE

A. Maintain all exterior plants covered by this Section, as required to establish healthy, viable plantings, including the following maintenance requirements during the maintenance period indicated in Part 1 of this Section:

1. Mowing;
2. Edging;
3. Pruning;
4. Cultivating;

5. Watering,

    a. Keep tree water bags filled at all times
    b. Do not allow plants to wilt at any time
    c. Contractor is responsible for all irrigation until final acceptance at the end of the maintenance period.

6. Weeding;
7. Fertilizing;
8. Mulching;
9. Restoring plant saucers for trees;
10. Maintaining trees support systems at correct tension;
11. Resetting plants to proper grade and vertical position;
12. Insect and Pest Control as required to keep plants free of insects and disease;
13. Restoring or replacing damaged tree wrappings;
14. Removal of trash and debris; and
15. Replacing dead or dying plants.

3.14 FINAL ACCEPTANCE

A. Inspection to determine Final Acceptance of planted areas will be made by the Landscape Architect upon Contractor's request at completion of the two-year Warranty Period. Provide notification at least fifteen (15) working days before requested inspection date.

1. Planted areas will be acceptable provided all requirements, including plant replacements and maintenance, have been complied with and healthy, thriving, and growing plants are established.
2. Remove all Tree Staking and Guying materials prior to Final Acceptance inspection.
3. Knock down, regrade, and re-mulch all tree pit saucers prior to Final Acceptance inspection.

3.15 CLEANUP AND PROTECTION

A. During exterior planting, keep adjacent pavings and construction clean and work area in an orderly condition.

B. Protect exterior plants from damage due to landscape operations, operations by other contractors and trades, and others. Maintain protection during installation and maintenance periods. Treat, repair, or replace damaged exterior planting.

3.16 DISPOSAL

A. Disposal: Remove surplus soil and waste material, including excess subsoil, unsuitable soil, trash, and debris, and legally dispose of off Owner's property.

END OF SECTION

This page is intentionally left blank.

SECTION 32 96 00 - TRANSPLANTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes transplanting non-nursery-grown trees by tree spade or digging and boxing.

B. Related Requirements:

1. Section 015639 "Temporary Tree and Plant Protection" for protecting, trimming, pruning, repairing, and replacing existing trees to remain that interfere with, or are affected by, execution of the Work.
2. Section 329300 "Exterior Plants" for new trees from nursery-grown sources.

1.3 DEFINITIONS

A. General: See definitions in ANSI A300 (Part 6) and in ANSI Z60.1 pertaining to field-grown trees, except as otherwise defined in this Section.

B. Caliper: Diameter of a trunk as measured by a diameter tape or the average of the smallest and largest diameters at a height 6 inches above the root flair for trees up to, and including, 4-inch size at this height; and as measured at a height of 12 inches above the root flair for trees larger than 4-inch size.

C. Root-Ball Depth: Measured from bottom of trunk flare to the bottom of root ball.

D. Root-Ball Width: Measured horizontally across the root ball with an approximately circular form or the least dimension for non-round root balls, not necessarily centered on the tree trunk, but within tolerance according to ANSI Z60.1.

E. Root Flare: Also called "trunk flare." The area at the base of the tree's stem or trunk where the stem or trunk broadens to form roots; the area of transition between the root system and the stem or trunk.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review methods and procedures related to transplanting work include, but are not limited to, the following:

a. Construction schedule. Verify availability of materials, personnel, equipment, and unimpeded access needed to make progress and avoid delays.

b. Tree and plant protection.
c. Tree maintenance.
d. Arborist's responsibilities.
e. Restrictions: weather, equipment, personnel, availability of replanting site. Arborist must be on site during the procedure.
f. Conditions for holding the tree if there will be a delay in planting.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples for Verification: For each of the following:

1. Weed-control barriers.
2. Proprietary Root-Ball-Stabilization Device: One unit.
3. Slow-Release Watering Device: One unit of each size required.

C. Pruning Schedule: Written schedule prepared by arborist detailing scope and extent of pruning each tree in preparation for and subsequent to transplanting.

1. Species and size of plant.
2. Location on site plan. Include unique identifier for each.
3. Reason for pruning.
4. Seasonal limitations on pruning.
5. Preparatory Pruning: Time schedule and description of preparatory pruning to be performed.

a. Indicate time in months preceding the extraction of the tree.
b. Indicate diameter of root ball and depth of root pruning for each tree.

6. Description of root and crown pruning during and subsequent to transplanting.
7. Description of maintenance following pruning.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified tree-service firm and arborist.

B. Certification: From arborist, certifying that transplanted trees have been protected during construction and that trees were promptly and properly treated and repaired when damaged.

C. Maintenance Recommendations: From arborist, recommended procedures to be established by Government for care and protection of trees after completing the Work.

1. Submit before completing the Work.

D. Existing Conditions: Documentation of existing trees indicated to be transplanted, which establishes preconstruction conditions that might be misconstrued as damage caused by construction activities.

1. Use sufficiently detailed color photographs or video recordings. Color shall accurately depict hue condition of foliage and bark.
2. Include drawings and notations to indicate specific wounds and damage conditions of each tree designated to be transplanted.

E. Tree-Transplanting Program: Submit before work begins.

F. Sample Warranties: For special warranties.

G. Tree-maintenance reports.

1.7 QUALITY ASSURANCE

A. Tree-Service Firm Qualifications: An experienced landscaping contractor or tree-moving firm that has successfully completed the transplanting of similar sized oak trees as similar to that required for this Project and that will assign an experienced, qualified arborist to Project site during execution of the Work.

1. Arborist Qualifications: Certified Arborist as certified by ISA.

B. Tree-Transplanting Program: Prepare a written plan by arborist for transplanting trees for the whole Project, including each phase or process, tree maintenance, and protection of surrounding materials during operations. Describe in detail the materials, methods, and equipment to be used for each phase of the transplanting work.

1. Include transplanting times appropriate for each species at the Project location unless otherwise indicated on Drawings or directed by arborist.
2. Include a transplanting schedule for each species to be transplanted, coordinated with the Project schedule.
3. Include site plans clearly marked to show tree-moving routes from extraction to planting locations. Indicate proposed equipment, weight, and turning radii.
4. Show details of temporary protective barriers where needed.
5. Include diagrams showing clearances to utility lines and other encumbrances along route.
6. Include care and maintenance provisions and eventual removal of tree stabilization.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of conformance with state and federal laws if applicable.

B. Bulk Materials:

1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or trees.
2. Provide erosion-control measures to prevent erosion or displacement of bulk materials, discharge of soil-bearing water runoff, and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
3. Accompany each delivery with appropriate certificates.

C. Protect bark, branches, and root systems from sun scald, drying, wind burn, sweating, whipping, and other handling and tying damage. Do not bend or bind-tie trees in such a manner as to destroy their natural shape.

D. Completely cover foliage when transporting trees while they are in foliage.

E. Handle trees by root ball. Do not drop trees.

F. Move trees after preparations for planting have been completed and install immediately. If planting is delayed more than six hours after moving, set trees in their appropriate aspect (sun, filtered sun, or shade), protect from weather and mechanical damage, and keep roots moist.

1.9 FIELD CONDITIONS

A. Field Measurements: Verify final grade elevations and final locations of trees and construction contiguous with trees by field measurements before proceeding with transplanting work. Perform transplanting only after finish grades are established.

B. Seasonal Restrictions: Transplant trees during the following in-season periods:

1. Early Spring: February -March, before Spring budding.

C. Weather Limitations: Proceed with transplanting only when existing and forecasted weather conditions permit planting to be performed when beneficial and optimum results may be obtained. Do not transplant during excessively wet or frozen conditions. Apply products during favorable weather conditions according to manufacturer's written instructions and warranty requirements.

D. Coordination with Turf Areas (Lawns): Perform transplanting before planting turf areas unless otherwise indicated.

1. When transplanting after planting turf areas, protect turf areas, and promptly repair damage caused by transplanting operations.

E. Coordination with Planting Beds: Perform transplanting before planting bedded areas unless otherwise indicated.

1. When transplanting after planting bedded areas, protect bedding plants, and promptly repair damage caused by transplanting operations.

1.10 WARRANTY

A. Installer's Special Warranty: Tree-service firm agrees to repair or replace trees and related materials that fail within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Death and unsatisfactory growth except for defects resulting from abuse, lack of adequate maintenance, or neglect by Government, or incidents that are beyond Contractor's control.
b. Death and unsatisfactory growth is defined as more than 15 percent dead or in an unhealthy condition or failure to meet general performance requirements at end of warranty period.
c. Structural failures including trees falling or blowing over.
d. Faulty performance of materials and devices related to tree plantings including tree stabilization and watering devices.

2. Warranty Periods from Date of Transplanting Completion:

a. Trees: 24 months.

3. Include the following remedial actions as a minimum:

    a. Remove dead trees and trees with unsatisfactory growth at end of warranty period; replace when directed.
    b. A limit of one replacement of the same species, variety and caliper for each tree will be required except for losses or replacements due to failure to comply with requirements.
    c. Replace materials and devices related to tree plantings.
    d. Provide extended warranty for period equal to original warranty period, for replaced trees.

1.11 MAINTENANCE SERVICE

A. Initial Maintenance Service: Provide tree maintenance by skilled employees of tree-service firm and as required in Part 3. Begin maintenance immediately after preparatory pruning and continue until plantings are healthy and well established but for not less than maintenance period below.

    1. Maintenance Period: 24 months from date of Substantial Completion.

B. Continuing Maintenance Proposal: From tree-service firm to the Owner, in the form of a standard yearly (or other period) maintenance agreement, starting on date initial maintenance service is concluded. State services, obligations, conditions, and terms for agreement period and for future renewal options.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. General Performance: Transplanted trees shall be healthy and resume vigorous growth within two years of transplanting without dieback due to defective extracting, handling, planting, maintenance, or other defects in the Work.

2.2 PLANTING MATERIALS

A. Backfill Soil: Excavated soil mixed with planting soil of suitable moisture content and granular texture for placing and compacting in planting pit around tree, and free of stones, roots, plants, sod, clods, clay lumps, pockets of coarse sand, concrete slurry, concrete layers or chunks, cement, plaster, building debris, and other extraneous materials harmful to plant growth.

    1. Mixture: Well-blended mix of two parts excavated soil to one part planting soil.
    2. Planting Soil: Planting soil as specified in Section 329115 “Soil Preparation”.

2.3 TREE-STABILIZATION MATERIALS

A. Trunk-Stabilization Materials:

    1. Upright and Guy Stakes: Rough-sawn, sound, new hardwood free of knots, holes, cross grain, and other defects, 2-by-2-inch nominal by length indicated, pointed at one end.

2. Wood Deadmen: Timbers measuring 8 inches in diameter and 48 inches long, treated with specified wood preservative treatment by pressure process.
3. Flexible Ties: Wide rubber or elastic bands or straps.
4. Guys and Tie Wires: ASTM A 641/A 641M, Class 1, galvanized-steel wire, two-strand, twisted, 0.106 inch in diameter.
5. Tree-Tie Webbing: UV-resistant polypropylene or nylon webbing with brass grommets.
6. Guy Cable: Five-strand, 3/16-inch- diameter, galvanized-steel cable, fitted with zinc-coated 3/8-inch galvanized eyebolts at ends.
7. Flags: Standard surveyor's plastic flagging tape, white, 6 inches long.

B. Root-Ball-Stabilization Materials:

1. Upright Stakes and Horizontal Hold-Down: Rough-sawn, sound, new hardwood or softwood, free of knots, holes, cross grain, and other defects, 2-by-2-inch nominal by length indicated; stakes pointed at one end.
2. Wood Screws: Hot-dip galvanized or stainless steel.

2.4 WATERING DEVICES

A. Slow-Release Watering Device: Standard product manufactured for drip-irrigation of plants and emptying its water contents over a period of 2 to 9 hours; manufactured from UV-light stabilized nylon-reinforced polyethylene sheet, PVC, or HDPE plastic.

B. Watering devices should be checked each week to ensure that they are properly functioning.

2.5 MISCELLANEOUS PRODUCTS

A. Organic Mulch: Shredded hardwood as specified in Section 329300 "Exterior Plants."

B. Anti-desiccant: Water-insoluble emulsion, permeable moisture retarder, film forming, for trees. Deliver in original, sealed, and fully labeled containers and mix according to manufacturer's written instructions.

C. Burlap: Non-synthetic, biodegradable.

D. Pesticides: Pesticide registered and approved by EPA, acceptable to authorities having jurisdiction, and of type recommended in writing by manufacturer for each specific problem and as required for Project conditions and application. Do not use restricted pesticides unless authorized in writing by authorities having jurisdiction.

1. Pre-Emergent Herbicide (Selective and Non-Selective): Effective for controlling the germination or growth of weeds within planted areas at the soil level directly below the mulch layer.
2. Post-Emergent Herbicide (Selective and Non-Selective): Effective for controlling weed growth that has already germinated.

E. Planting Tablets: Tightly compressed chip type, long-lasting, slow-release, commercial-grade planting fertilizer in tablet form. Tablets shall break down with soil bacteria, converting nutrients into a form that can be absorbed by plant roots.

1. Size: 5-gram tablets.
2. Nutrient Composition: 20 percent nitrogen, 10 percent phosphorous, and 5 percent potassium, by weight plus micronutrients.

F. Weed-Control Barriers:

1. Nonwoven Geotextile Filter Fabric: Polypropylene or polyester fabric, 3 oz./sq. yd. minimum, composed of fibers formed into a stable network so that fibers retain their relative position. Fabric shall be inert to biological degradation and resist naturally encountered chemicals, alkalis, and acids.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Erosion and Sedimentation Control: Examine the site to verify that temporary erosion- and sedimentation-control measures are in place. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross transplanting areas.

B. For the record, prepare written report, endorsed by arborist, listing conditions detrimental to transplanting work and tree protection and health.

C. Proceed with transplanting only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, other facilities, turf areas, and other plants and planting areas from damage caused by transplanting operations.

B. Utility Locator Service: Notify "Miss Utility" for area where Project is located before beginning excavation when located within Public Space and contract with a private firm to locate utilities on Federal Government Property. Private utility locator service companies and employees to be approved by the Federal Government to perform work on Federal Government Property.

C. Locate and clearly identify tree for transplanting. Tie a 1-inch blue-vinyl tape around each tree at 54 inches above the ground.

D. Lay out transplant location. Stake location, adjust locations when requested and obtain Landscape Architect's acceptance of layout before transplanting. Make minor adjustments as required.

E. Apply anti-desiccant to trees uniformly, using power spray to provide an adequate film over trunks (before wrapping), branches, stems, twigs, and foliage to protect during extracting, handling, and transportation.

1. If deciduous trees are moved in full leaf, spray with anti-desiccant before extracting and again two weeks after transplanting.

F. Wrap trees with burlap fabric over trunks, branches, stems, twigs, and foliage to protect from wind and other damage during extracting, handling, and transporting.

3.3 PREPARATORY PRUNING

A. Root Pruning: Perform preparatory root pruning under direction of arborist as far in advance of extracting each tree as the Project Schedule allows.

1. Dig exploratory pits or trench by hand or with air-spade around perimeter of tree at indicated root-ball width to determine locations of main lateral roots.
2. Dig trench by hand or with tree spade around perimeter of tree at indicated root-ball width to the depth of the root system. Do not use a backhoe or other equipment that rips, tears, or pulls roots.
3. Root-Ball Width: Minimum 9 inches of root-ball diameter, or least dimension for non-round root balls, for each inch of tree caliper being transplanted.
4. If encountering large, main lateral roots, expose roots beyond excavation limits as required to bend and redirect them without breaking.
5. Use narrow-tine spading forks to comb soil to expose roots with minimal damage to root system.
6. Cut exposed roots manually with sharp pruning instruments; do not break, tear, chop, or slant the cuts. Do not use a backhoe or other equipment that rips, tears, or pulls roots.
7. Do not paint or apply sealants on cut root ends.
8. Backfill trench with excavated soil.

B. Crown Pruning (Tip Pruning):

1. Perform preparatory crown pruning only as directed by arborist and approved in writing by the Landscape Architect. Follow procedures as specified in "Crown Pruning" Article.

3.4 EXCAVATION AND PLANTING EQUIPMENT

A. Tree Spade: Track-mounted mechanized tree mover; sized according to manufacturer's size recommendation for each tree being transplanted.

3.5 EXCAVATING PLANTING PITS

A. General: Excavate under supervision of the arborist.

1. Excavate planting pits or trenches with sides sloping. Trim perimeter of bottom leaving center area of bottom raised slightly to support root ball and assist in drainage away from center. Do not further disturb base. Ensure that root ball will sit on undisturbed base soil. Scarify sides of planting pit smeared or smoothed during excavation.
2. Excavate approximately three times as wide as root ball.
3. Keep excavations covered or otherwise protected until replanting trees.

B. Obstructions: Notify Landscape Architect if unexpected rock or obstructions detrimental to trees are encountered in excavations.

1. Hardpan Layer: Drill 6-inch- diameter holes, 24 inches apart, into free-draining strata or to a depth of 10 feet, whichever is less, and backfill with free-draining material.

C. Seepage: Notify Landscape Architect if subsoil conditions evidence unexpected water seepage into tree-planting pits.

D. Drainage: Fill planting pit or trench with 6 inches of water and time the infiltration rate of the soil. If the drainage rate is less than 0.25 inch per hour, notify Landscape Architect to determine need for subsurface drainage.

E. Saline or Sodic Soils: Completely fill excavations with water and allow to percolate away before positioning trees.

3.6 EXTRACTING TREES

A. General: Extract trees under supervision of the arborist and Landscape Architect.

B. Orientation Marking: Mark the north side of each tree with non-permanent paint before extracting.

C. Root-Ball Width: Minimum 12 inches of root-ball diameter, or least dimension for non-round root balls, for each inch of tree caliper being transplanted.

D. Root-Ball Depth: As determined by the arborist for each species and size of tree and for site conditions at original and planting locations.

E. Digging:

1. Dig and clear a pit by hand or with tree spade to the depth of the root system as defined by the Arborist. Do not use a backhoe or other equipment that rips, tears, or pulls roots.
2. Use narrow-tine spading forks to comb soil to expose roots with minimal damage to root system.
3. If encountering large, main lateral roots, expose roots beyond excavation limits as required to bend and redirect them without breaking.
4. Cut exposed roots manually with sharp pruning instruments; do not break, tear, chop, or slant the cuts. Do not paint or apply sealants on cut root ends.
5. Construct box tight against root system sides and bottom as pit is dug. Brace and support box to prevent breaking of root ball.
6. Temporarily support and protect exposed roots from damage until they are permanently redirected and covered with soil. Cover roots with burlap and keep them moist until planted.

F. Extracting with Tree Spade: Use the same tree spade to extract the tree as will be used to transport and plant the tree.

1. Do not use tree spade to move trees larger than the manufacturer's maximum size recommendation for the tree spade being used.
2. When extracting the tree, center the trunk within the tree spade and move tree with a solid ball of earth.

3.7 PLANTING

A. Planting Standard: Perform planting according to ANSI A300 (Part 6) unless otherwise indicated.

B. Fill excavations with water and allow to percolate away before positioning trees.

C. Before planting, verify that root flare is visible at top of root ball. If root flare is not visible, carefully remove soil in a level manner from the root ball to where the top-most root emerges

from the trunk. After soil removal to expose the root flare, verify that root ball still meets size requirements.

D. Ensure that root flare is visible after planting.

E. Remove injured roots by cutting cleanly; do not break. Do not paint or apply sealants on cut root ends.

F. Orientation: Position the tree so that its north side, marked before extracting, is facing north in its new location.

G. Set tree plumb and in center of planting pit with the top of root flare (not the adventitious roots or graft swell) one (1) inch above adjacent finish grades.

1. Use specified backfill soil for backfill.
2. If area under the tree was initially dug too deep, add backfill to raise it to the correct level and thoroughly tamp the added soil to prevent settling.
3. After placing some backfill around root ball to stabilize plant, remove any foreign materials used to hold the ball above that point and begin backfilling.
4. Backfill around root ball in layers, tamping to settle soil and eliminate voids and air pockets. When planting pit is approximately one-half filled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed.
5. Redirect exposed root ends downward in backfill areas where possible. Hand-expose roots as required to bend and redirect them without breaking. If encountered immediately adjacent to location of new construction and redirection is not practical, cut roots approximately three (3) inches back from new construction and as required for root pruning.
6. Place planting tablets in each planting pit when pit is approximately one-half filled; in amounts recommended by arborist. Place tablets beside the root ball about one (1) inch from root tips; do not place tablets in bottom of the hole.
7. Continue backfilling process. Water again after placing and tamping final layer of soil.
8. Remove any excess soil from the site.

H. Planting with Tree Spade: Use the same tree spade for planting as was used to extract and transport the tree. Do not use tree spade for trees larger than the manufacturer's maximum size recommendation for the tree spade being used.

I. Slopes: When planting on slopes, set the tree so the root flare on the uphill side is flush with the surrounding soil on the slope; the edge of the root ball on the downhill side will be above the surrounding soil. Apply enough soil to cover the downhill side of the root ball.

3.8 CROWN PRUNING

A. Prune branches as directed by arborist and approved by the Landscape Architect.

1. Prune to remove only injured, broken, dying, or dead branches. Do not prune for shape.
2. Do not remove or reduce living branches to compensate for root loss caused by cutting root system or to improve natural tree form.
3. Pruning Standards: Perform pruning according to ANSI A300 (Part 1).

B. Unless otherwise directed by arborist and acceptable to Landscape Architect, do not cut tree leaders.

C. Cut branches with sharp pruning instruments; do not break or chop.

D. Do not paint or apply sealants to wounds.

E. Provide subsequent maintenance during Contract period as recommended by arborist and approved by the Landscape Architect.

F. Chip removed branches and dispose of off-site.

3.9 TREE STABILIZATION

A. Trunk Stabilization by Staking and Guying: Install trunk stabilization as follows unless otherwise indicated on Drawings or directed by arborist.

1. Site-Fabricated Staking-and-Guying Method: Install no fewer than three guys spaced equally around tree.

a. Securely attach guys to stakes 30 inches long, driven to grade. Adjust spacing to avoid penetrating root balls or root masses. Provide turnbuckle for each guy wire and tighten securely.
b. For trees more than 6 inches in caliper, anchor guys to wood deadmen buried at least 36 inches below grade. Provide turnbuckle for each guy wire and tighten securely.
c. Attach flags to each guy wire, 30 inches above finish grade.
d. Paint turnbuckles with luminescent white paint.

3.10 MULCHING

A. Install weed-control barriers before mulching according to manufacturer's written instructions. Completely cover area to be mulched, overlapping edges a minimum of 12 inches (300 mm) and secure seams with galvanized pins.

B. Organic Mulch: Apply 3-inch average thickness of organic mulch extending 12 inches beyond edge of individual planting pit, and finish level with adjacent finish grades. Do not place mulch within three (3) inches of trunks or stems.

3.11 INSTALLING SLOW-RELEASE WATERING DEVICE

A. Provide one device for each tree.

B. Place device on top of the mulch at base of tree and fill with water according to manufacturer's written instructions.

C. Test to make sure the device is not faulty, and the water is able to be released.

3.12 TREE MAINTENANCE

A. Perform tree maintenance as recommended by arborist and approved by the Landscape Architect. Maintain arborist observation of transplanting work.

B. Maintain trees by cultivating, watering, weeding, fertilizing, mulching, restoring planting saucers, adjusting and repairing tree-stabilization devices, resetting to proper grades or vertical position, and performing other operations as required to establish healthy, viable plantings. Treat as

required to keep trees free of insects and disease. Prune only with the approval of the Landscape Architect and under the supervision of the Arborist.

C. From time of preparatory root pruning measure soil moisture adjacent to edge of each root ball weekly. Record findings and weather conditions.

D. Fill areas of soil subsidence with backfill soil. Replenish mulch materials damaged or lost in areas of subsidence.

E. Apply treatments as required to keep tree materials, planted areas, and soils free of pests and pathogens or disease. Use integrated pest management practices whenever possible to minimize the use of pesticides and reduce hazards. Treatments include physical controls such as hosing off foliage, mechanical controls such as traps, and biological control agents.

F. Pesticide Application: Apply pesticides and other chemical products and biological control agents in accordance with authorities having jurisdiction and manufacturer's written instructions. Coordinate applications with Government's operations and others in proximity to the Work. Notify Government before each application is performed.

1. Pre-Emergent Herbicides (Selective and Non-Selective): Apply in accordance with manufacturer's written instructions. Do not apply to seeded areas.
2. Post-Emergent Herbicides (Selective and Non-Selective): Apply only as necessary to treat already-germinated weeds and in accordance with manufacturer's written instructions.

G. Reports: Have arborist prepare monthly inspection reports.

3.13 REPAIR AND REPLACEMENT

A. General: Repair or replace transplanted trees and other plants indicated to remain or be relocated that are damaged by construction operations, in a manner recommended by the arborist and approved by the Landscape Architect.

1. Submit details of proposed pruning and repairs.
2. Perform repairs of damaged trunks, branches, and roots within 24 hours according to arborist's written instructions.
3. Replace trees and other plants that cannot be repaired and restored to full-growth status, as determined by the Landscape Architect.

B. Remove and replace trees that are more than 15 percent dead or in an unhealthy condition before the end of the corrections period or are damaged during construction operations that the Landscape Architect determines are incapable of restoring to normal growth pattern.

1. Provide new trees of same size as those being replaced for each tree of 4 inches or smaller in caliper size.
2. Provide one new tree(s) of 6-inch caliper size for each tree being replaced that measures more than 6 inches in caliper size.
3. Species of Replacement Trees: Same species being replaced.

3.14 CLEANUP AND PROTECTION

A. During transplanting, keep adjacent paving and construction clean and work area in an orderly condition.

B. Protect trees from damage due to transplanting operations and operations of other contractors and trades. Maintain protection during transplanting and maintenance periods. Treat, repair, or replace damaged plantings.

C. After planting and before Substantial Completion, remove tags, markings, tie tape, labels, wire, burlap, and other debris from transplanted trees, planting areas, and Project site.

3.15 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Except for materials indicated to be recycled, remove surplus soil, excess excavated material, waste materials, displaced plants, trash, and debris, and legally dispose of them off Government's property.

END OF SECTION

This page is intentionally left blank.

SECTION 33 14 15 - SITE WATER DISTRIBUTION PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Water-distribution piping and related components outside the building for combined domestic water service and fire-suppression water service and terminated 5 ft. from building. Terminate water-service piping with appropriate fitting for extension by Division 22.

B. Related Requirements:

1. Section 211300 "Fire Protection."

1.2 DEFINITIONS

A. CDA: Copper Development Association.

B. EPDM: Ethylene-propylene-diene terpolymer rubber.

C. PA: Polyamide (nylon) plastic.

D. PE: Polyethylene plastic.

E. PP: Polypropylene plastic.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings:

1. Detail precast concrete vault assemblies and indicate dimensions, method of field assembly, and components.

1.4 INFORMATIONAL SUBMITTALS

A. Field Quality-Control Submittals:

1. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For each type of product indicated.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Preparation for Transport: Prepare piping, valves, meters, backflow prevention devices, and fire hydrants according to the following:

1. Ensure that piping, valves, meters, backflow prevention devices, and fire hydrants are dry and internally protected against rust and corrosion.
2. Protect threaded ends and flange faces against damage.
3. Set piping, valves, meters, backflow prevention devices, and fire hydrants in best position for handling and to prevent rattling.

B. During Storage: Use precautions for piping, valves, meters, backflow prevention devices, and fire hydrants according to the following:

1. Do not remove end protectors unless necessary for inspection; then reinstall for storage.
2. Protect from weather. Store indoors and maintain temperature higher than ambient dew point temperature. Support off the ground or pavement in watertight enclosures when outdoor storage is necessary.

C. Handling: Use sling to handle products if size requires handling by crane or lift. Rig products to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

D. Deliver piping with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe-end damage and to prevent entrance of dirt, debris, and moisture.

E. Protect stored piping from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor when storing inside.

F. Protect flanges, fittings, and specialties from moisture and dirt.

G. Store plastic piping protected from direct sunlight. Support to prevent sagging and bending.

1.7 PROJECT CONDITIONS

A. Interruption of Existing Water-Distribution Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water-distribution service in accordance with requirements indicated:

1. Notify Architect no fewer than two days in advance of proposed interruption of service.
2. Do not proceed with interruption of water-distribution service without Architect's written permission.

1.8 COORDINATION

A. Coordinate connection to water main with utility company.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Comply with requirements of utility company supplying water. Include tapping of water mains and backflow prevention.

B. Comply with standards of authorities having jurisdiction for domestic water-service piping, including materials, installation, testing, and disinfection.

C. Comply with standards of authorities having jurisdiction for fire-suppression water-service piping, including materials, hose threads, installation, and testing.

D. Piping materials to bear label, stamp, or other markings of specified testing agency.

E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a testing agency acceptable to authorities having jurisdiction, and marked for intended location and application.

F. Comply with ASTM F645 for selection, design, and installation of thermoplastic water piping.

G. Comply with FM Approvals' "Approval Guide" and/or UL's "Fire Protection Equipment Directory" for fire-suppression water-service products.

H. Comply with NFPA 24 for materials, installations, tests, flushing, and valve and hydrant supervision for fire-suppression water-service piping.

I. All piping and appurtenances intended to convey or dispense water for human consumption are to comply with the U.S. Safe Drinking Water Act (SDWA), with requirements of the Authority Having Jurisdiction (AHJ), and with NSF 61/NSF 372 or are certified in compliance with NSF 61/NSF 372 by an ANSI-accredited third-party certification body, that the weighted average lead content at wetted surfaces is less than or equal to 0.25 percent.

2.2 PIPING MATERIALS

A. Comply with requirements in "Piping Applications" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and service sizes.

B. Potable-water piping and components comply with NSF 14, NSF 61, and NSF 372. Include marking "NSF-pw" on piping.

2.3 DUCTILE-IRON PIPE AND FITTINGS

A. Mechanical-Joint, Ductile-Iron Pipe:

1. AWWA C151/A21.51, with mechanical-joint bell and plain spigot end.
2. AWWA C104/A21.4 cement mortar-lined.
3. All Ductile Iron Pipe materials shall be Class 52.
4. All Gaskets shall be MJ Field Lok at all joints and all pipes shall have MEGALUG Mechanical Joint Retraint or approved equivalent.

B. Mechanical-Joint, Ductile-Iron Fittings:

1. AWWA C110, ductile- or gray-iron standard pattern or AWWA C153/A21.53, ductile-iron compact pattern.
2. Glands, Gaskets, and Bolts: AWWA C111/A21.11, ductile- or gray-iron glands, rubber gaskets, and steel bolts.
3. AWWA C104/A21.4 cement mortar-lined.
4. All Ductile Iron Fittings shall be Class 52.
5. All Gaskets shall be MJ Field Lok at all joints and all fittings shall have MEGALUG Mechanical Joint Retraint or approved equivalent.

2.4 PIPING JOINING MATERIALS

A. Gaskets for Ferrous Piping and Copper-Alloy Tubing: ASME B16.21, asbestos free.

B. Plastic Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer unless otherwise indicated.

2.5 ENCASEMENT FOR PIPING

A. Standards: ASTM A674 or AWWA C105/A21.5.

B. Form: Sheet or tube.

C. Material: Linear low-density PE film of 0.008-inch minimum thickness or high-density, cross-laminated PE film of 0.004-inch minimum thickness.

D. Color: Black.

2.6 GATE VALVES

A. Gate Valves - AWWA, Cast Iron:

1. Source Limitations: Obtain gate valves - AWWA, cast iron, from single manufacturer.
2. Gate Valves - Nonrising Stem, Resilient Seated: Cast- or ductile-iron body and bonnet, with bronze or cast- or ductile-iron gate, resilient seats, bronze stem, and stem nut.

    a. Standards: AWWA C509 or AWWA C515.
    b. Minimum Pressure Rating: 250 psig.
    c. End Connections: Mechanical joint.
    d. Interior Coating: Complying with AWWA C550.

2.7 GATE VALVE ACCESSORIES AND SPECIALTIES

A. Tapping-Sleeve Assemblies: Sleeve and valve compatible with drilling machine.

1. Source Limitations: Obtain tapping-sleeve assemblies from single manufacturer.
2. Standard: MSS SP-60.
3. Tapping Sleeve: Cast- or ductile-iron or stainless steel, two-piece bolted sleeve with flanged outlet for new branch connection. Include sleeve matching size and type of pipe material being tapped and with recessed flange for branch valve.
4. Valve: AWWA, cast-iron, nonrising-stem, resilient-seated gate valve with one raised face flange mating tapping-sleeve flange.

B. Valve Boxes: Comply with AWWA M44 for cast-iron valve boxes. Include top section, adjustable extension of length required for depth of burial of valve, plug with lettering "WATER," and bottom section with base that fits over valve and with a barrel approximately 5 inches in diameter.

1. Operating Wrenches: Steel, tee-handle with one pointed end, stem of length to operate deepest buried valve, and socket matching valve operating nut.

2.8 WATER METERS

A. Water Meter - Utility Company Furnished: Water meters will be furnished and shall be a Neptune Ultrasonic Meter.

1. Utility Company: City of Annapolis.

2.9 CONCRETE VAULTS

A. Concrete Vault - Precast, Reinforced Concrete: Designed for A-16 load designation in accordance with ASTM C857 and made in accordance with ASTM C858.

1. Ladder: ASTM A36/A36M, steel or PE-encased steel steps.
2. Manhole:

a. ASTM A48/A48M Class No. 35A minimum tensile strength, gray-iron traffic frame and cover; 24-inch minimum diameter unless otherwise indicated.
b. ASTM A536, Grade 60-40-18, ductile-iron traffic frame and cover: 24-inch minimum diameter unless otherwise indicated.

3. Drain: ASME A112.6.3, cast-iron floor drain with outlet of size indicated. Include body anchor flange, light-duty cast-iron grate, bottom outlet, and integral or field-installed bronze ball or clapper-type backwater valve.

2.10 FIRE HYDRANTS

A. Fire Hydrants - Dry Barrel:
1. Source Limitations: Obtain fire hydrants - dry barrel, from single manufacturer, shall be Kennedy, and approved by the City of Annapolis.
2. Pressure Rating: 250 psig.
3. Standard: AWWA C502.
4. Freestanding configuration, with one NPS 4-1/2 and two NPS 2-1/2 outlets, 5-1/4-inch main valve, drain valve, and NPS 6 mechanical-joint inlet. Include interior coating in accordance with AWWA C550. Hydrant to have cast-iron body, compression-type valve opening against pressure and closing with pressure.
5. Standards: UL 246, and FM Global approved.
6. Freestanding configuration, with one NPS 4-1/2 and two NPS 2-1/2 outlets, 5-1/4-inch main valve, drain valve, and NPS 6 mechanical-joint inlet. Hydrant to have cast-iron body, compression-type valve opening against pressure and closing with pressure.

a. Outlet Threads: NFPA 1963, with external hose thread used by local fire department. Include cast-iron caps with steel chains.
b. Operating and Cap Nuts: Pentagon, 1-1/2 inches point to flat.

c. Direction of Opening: Open hydrant valve by turning operating nut to left or counterclockwise.
d. Exterior Finish: Red alkyd-gloss enamel paint unless otherwise indicated.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Comply with excavating, trenching, and backfilling requirements in Section 312000 "Earth Moving."

3.2 PIPING APPLICATIONS

A. Transition couplings and special fittings with pressure ratings at least equal to piping pressure rating may be used unless otherwise indicated.

B. Do not use flanges or unions for underground piping.

C. Flanges, unions, grooved-end-pipe couplings, and special fittings may be used, instead of joints indicated, on aboveground piping and piping in vaults.

D. Underground Combined Water-Service and Fire-Service-Main Piping NPS 6 to NPS 12 to be any of the following:

1. Ductile-iron, see applications for Pipe and Fittings in Section 2.3.

3.3 VALVE APPLICATIONS

A. General Application: Use mechanical-joint-end valves for NPS 3 and larger underground installation. Use threaded- or flanged-end valves for installation in vaults. Use UL/FM Global, nonrising-stem gate valves for installation with indicator posts. Use corporation valves and curb valves with ends compatible with piping, for NPS 2 and smaller installation.

B. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:

1. Underground Valves, NPS 3 and Larger: AWWA, cast-iron, nonrising-stem, high-pressure, resilient seated gate valves with valve box.
2. Underground Valves, NPS 4 and Larger, for Indicator Posts: UL/FM Global, cast-iron, nonrising-stem gate valves with indicator post.
3. Use the following for valves in vaults and aboveground:

a. Gate Valves, NPS 2 and Smaller: Bronze, nonrising stem.
b. Gate Valves, NPS 3 and Larger: AWWA, cast iron, OS&Y rising stem, resilient seated.
c. Check Valves: AWWA C508, swing type.

4. Detector Check Valves: Use for water-service piping in vaults and aboveground to detect unauthorized use of water.

3.4 INSTALLATION OF PIPING

A. Water-Main Connection:

1. Arrange with utility company for tap of size and in location indicated in water main.
2. Tap water main in accordance with requirements of water utility company and of size and in location indicated.

B. Make connections larger than NPS 2 with tapping machine according to the following:

1. Install tapping sleeve and tapping valve in accordance with MSS SP-60.
2. Install tapping sleeve on pipe to be tapped. Position flanged outlet for gate valve.
3. Use tapping machine compatible with valve and tapping sleeve; cut hole in main. Remove tapping machine and connect water-service piping.
4. Install gate valve onto tapping sleeve. Comply with MSS SP-60. Install valve with stem pointing up and with valve box.

C. Comply with NFPA 24 for fire-service-main piping materials and installation.

1. Install PE corrosion-protection encasement in accordance with ASTM A674 or AWWA C105/A21.5.

D. Install ductile-iron, water-service piping in accordance with AWWA C600 and AWWA M41.

1. Install PE corrosion-protection encasement in accordance with ASTM A674 or AWWA C105/A21.5.

E. Bury piping with depth of cover over top at least 48 inches, with top at least 12 inches below level of maximum frost penetration.

F. Extend water-service and fire-suppression water-service piping and connect to water-supply source and building water-piping and fire-suppression piping systems at outside face of building wall in locations and pipe sizes indicated.

1. Terminate water-service and fire-suppression water-service piping at building wall until building water-piping and fire-suppression piping systems are installed. Terminate piping with caps, plugs, or flanges as required for piping material. Make connections to building water-piping and fire-suppression piping systems when those systems are installed.

G. Install underground piping with restrained joints at horizontal and vertical changes in direction. Use restrained-joint piping, thrust blocks, anchors, tie-rods and clamps, and other supports.

H. Comply with Section 211200 "Fire-Suppression Standpipes," Section 211313 "Wet-Pipe Sprinkler Systems," and Section 211316 "Dry-Pipe Sprinkler Systems" for fire-suppression-water piping inside the building.

I. Comply with Section 221116 "Domestic Water Piping" for potable-water piping inside the building.

3.5 JOINT CONSTRUCTION

A. Comply with Section 330500 "Common Work Results for Utilities" for basic piping joint construction.

B. Make pipe joints according to the following:

1. Ductile-Iron Piping, Gasketed Joints for Water-Service Piping: AWWA C600 and AWWA M41.
2. Ductile-Iron Piping, Gasketed Joints for Fire-Service-Main Piping: UL 194.

3.6 INSTALLATION OF ANCHORAGE

A. Anchorage: Install water-distribution piping with restrained joints. Anchorages and restrained-joint types that may be used include the following:

1. Concrete thrust blocks.
2. Locking mechanical joints.
3. Set-screw mechanical retainer glands.
4. Bolted flanged joints.

B. Install anchorages for tees, plugs and caps, bends, crosses, valves, and hydrant branches. Include anchorages for the following piping systems:

1. Gasketed-Joint, Ductile-Iron, Water-Service Piping: In accordance with AWWA C600.
2. Fire-Service-Main Piping: In accordance with NFPA 24.

C. Apply full coat of asphalt or other acceptable corrosion-resistant material to surfaces of installed ferrous anchorage devices.

3.7 INSTALLATION OF VALVES

A. AWWA Gate Valves: Comply with AWWA C600 and AWWA M44. Install each underground valve with stem pointing up and with valve box.

B. AWWA Valves Other Than Gate Valves: Comply with AWWA C600 and AWWA M44.

C. UL-Listed or FM Global-Approved Gate Valves: Comply with NFPA 24. Install each underground valve and valves in vaults with stem pointing up and with vertical cast-iron indicator post.

D. UL-Listed or FM Global-Approved Valves Other Than Gate Valves: Comply with NFPA 24.

E. MSS Valves: Install as component of connected piping system.

F. Comply with requirements for concrete piers in Section 033000 "Cast-in-Place Concrete" for support of valves and piping not direct buried.

3.8 INSTALLATION OF WATER METERS

A. Install water meters, piping, and specialties in accordance with utility company's written instructions.

B. Water Meters:

1. Install detector-type water meters in meter vault in accordance with AWWA M6. Include shutoff valves on water meter inlets and outlets and full-size valved bypass around meters. Support meters, valves, and piping on brick or concrete piers.

C. Support water meters and piping NPS 3 and larger on concrete piers. Comply with requirements for concrete piers in Section 033000 "Cast-in-Place Concrete."

3.9 INSTALLATION OF WATER METER BOXES

A. Install water meter boxes in paved areas flush with surface.

B. Install water meter boxes in grass or earth areas with top 2 inches above surface.

3.10 INSTALLATION OF CONCRETE VAULTS

A. Install precast concrete vaults in accordance with ASTM C891.

3.11 INSTALLATION OF FIRE HYDRANTS

A. Install each fire hydrant with separate gate valve in supply pipe, anchor with restrained joints or thrust blocks, and support in upright position.

B. Wet-Barrel Fire Hydrants: Install with valve below frost line. Provide for drainage.

C. AWWA Fire Hydrants: Comply with AWWA M17.

D. UL/FM Global Fire Hydrants: Comply with NFPA 24.

3.12 INSTALLATION OF FIRE DEPARTMENT CONNECTIONS

A. Install ball drip valves at each check valve for fire department connection to mains.

B. Install protective pipe bollards [**on two sides of**] [**on three sides of**] <**Insert arrangement**> each fire department connection. Pipe bollards are specified in Section 055000 "Metal Fabrications."

3.13 CONNECTIONS

A. See Section 330500 "Common Work Results for Utilities" for piping connections to valves and equipment.

B. Connect water-distribution piping to existing water main. Use tapping sleeve and tapping valve.

C. Connect water-distribution piping to interior domestic water and fire-suppression piping.

3.14 FIELD QUALITY CONTROL

A. Piping Tests: Conduct piping tests before joints are covered and after concrete thrust blocks have hardened sufficiently. Fill pipeline 24 hours before testing and apply test pressure to stabilize system. Use only potable water.

B. Hydrostatic Tests: Test at not less than one-and-one-half times working pressure for two hours.

1. Increase pressure in 50 psig increments and inspect each joint between increments. Hold at test pressure for one hour; decrease to 0 psig. Slowly increase again to test pressure and hold for one more hour. Maximum allowable leakage is 2 quarts per hour per 100 joints. Remake leaking joints with new materials and repeat test until leakage is within allowed limits.

C. Prepare reports of testing activities.

3.15 IDENTIFICATION

A. Install continuous underground detectable warning tape during backfilling of trench for underground water-distribution piping. Locate below finished grade, directly over piping. Underground warning tapes are specified in Section 312000 "Earth Moving."

3.16 CLEANING

A. Clean and disinfect water-distribution piping as follows:

1. Purge new water-distribution piping systems and parts of existing systems that have been altered, extended, or repaired before use.
2. Use purging and disinfecting procedure prescribed by authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described in NFPA 24 for flushing of piping. Flush piping system with clean, potable water until dirty water does not appear at points of outlet.
    a. Drain system or part of system of previous solution and refill with water/chlorine solution containing at least 200 ppm of chlorine; isolate and allow to stand for three hours.
    b. After standing time, flush system with clean, potable water until no chlorine remains in water coming from system.
    c. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedure if biological examination shows evidence of contamination.

B. Prepare reports of purging and disinfecting activities.

END OF SECTION

SECTION 33 41 99 - STORMWATER MANAGEMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Stormwater Management Plans and Report approved (green stamped) by the Maryland Department of the Environment.

1.2 SUMMARY

A. Section includes requirements for the inspection of stormwater management (SWM) facilities during construction activities as specified and submission of a stormwater management facility as-built certification package for each stormwater management facility constructed to the Maryland Department of the Environment within 45 calendar days of completing construction of all stormwater management facilities.

1.3 INFORMATION SUPPLIED BY THE OWNER

A. Upon written request, the Owner will provide CADD files in AutoCAD format and the approved Final SWM Report in PDF format to facilitate completion of the SWM facility as-built certification package.

1.4 STORMWATER MANAGEMENT CERTIFYING ENGINEER

A. The Contractor shall engage a Maryland registered Professional Engineer to perform the duties in this specification section.

B. The Certifying Engineer is responsible for assembling and certifying the SWM certification package. Duties include adequately documenting that the SWM facilities have been construction as specified and performing inspections during pertinent construction activities for the SWM facilities and practices. The Certifying Engineer shall be a Professional Engineer (P.E.) registered and licensed in the State of Maryland and who has at least three years of experience in SWM facility design and SWM facility construction.

C. The Certifying Engineer shall have the option to use designees, who are under the direct supervision of the Certifying Engineer, to perform the following duties on behalf of the Certifying Engineer.

1. Documenting that the SWM facilities have been constructed as specified including writing activity inspection reports, taking photographs, and obtaining copies of material approvals and material test reports.

2. Performing inspections during pertinent construction activities for the SWM facilities and practices, completing the pertinent portions of the SWM facility as-built certification data tables.

3. When the Certifying Engineer elects to use designees, submit the names and resumes indicating their experience in the design and inspection of SWM facilities, of those designees authorized by the Certifying Engineer to Certifying Engineer. Only authorized designees may represent the Certifying Engineer for the limited duties specified.

1.5 STORMWATER MANAGEMENT FACILITY AS-BUILT CERTIFICATION PACKAGE

A. The SWM facility as-built certification package contains documentation that verifies that all SWM facilities and practices on the Contact have been constructed as specified or are functionally equivalent to the designs in the approved SWM Report.

B. The SWM facility as-built certification shall include the following for each SWM facility in the Contract, presented neatly and legibly, and organized in an easy to follow format.

1. SWM facility construction inspection reports. The inspection reports shall include the following:

   a. The SWM facility deification number and type of SWM facility or practice.
   b. The date and location of the activity.
   c. Photographs, taken during inspections, that clearly show the construction activities as listed on the pertinent SWM facility as-built data tables, with narrative descriptions of what appears in the photographs, the dates of the photographs were taken, and the locations.
   d. Verification of whether SWM facility as-built construction is as specified, noting any deviations from the Contract Documents and how the deviations have been addressed.

2. Photographs of SWM facilities and practices after all landscaping has been installed and established, with narrative descriptions of what appears in the photographs.

3. Copies of pertinent material approval forms.

4. Copies of pertinent materials and installation test reports and results.

5. Completed as-built certifications data tables.

6. Green line as-built surveys of the SWM facilities and practices signed and sealed by a Professional Land Surveyor (PLS) who is registered and licensed in the State of Maryland. The as-built survey data shall be overlaid on the appropriate Contract plan sheet(s) and profile sheets, at the same scale and datum, and are coordinately correct. The as-built survey data shall be green in color, clearly legible and easily distinguishable from the Contract Document information. The SWM facility as-built surveys shall include the following:

   a. Contours. One-foot contour intervals or otherwise match the contour intervals shown in the Contract Documents. Contours shall cover the entire footprint of the SWM facility or practice as well as inflow and outflow conveyances when ditches or similar features convey runoff into or out of SWM facilities and practices.
   b. Drainage Structures. Includes all drainage structures within the footprint of the SWM facility, including but not limited to inlets, manholes, flow splitters, risers, weirs, end sections, headwalls, and end walls. As-built data shall include but is not limited to top of structure elevations, structure lengths, and structure widths; pipe inverts; pipe sizes, materials, and flow directions; orifice elevations; opening sizes;

weir dimensions and elevations; check dam locations and dimensions; grates; and trash racks.

c. Riprap and Aggregate. Includes dimensions of riprap and other areas within the footprint of the SWM facility and practice that show a surface layer of aggregate or riprap, including forebays.

d. Embankment Information. Includes embankment heights, widths, and elevations; clay core locations, dimensions, and elevations; cut-off trench locations, dimensions, and elevations; pertinent filter diaphragm information; and pertinent pipe cradle information. Data that cannot be obtained from a field survey shall be provided by the Certifying Engineer for inclusion with the SWM facility as-built survey.

e. SWM Facility Maintenance Access Roads.

f. Fences. Includes fence that surrounds the footprint of the SWM facility or practice.

g. SWM Facility Profiles. Includes an overlay of green line as-built data on SWM facility profiles and typical sections including but not limited to check dam spacing, check dam top elevations, check dam dimensions, invert elevations, subdrain sizes, subdrain materials, aggregate and soil thicknesses, material types, clay core dimensions, and cut-off trench dimensions. Data that cannot be obtained from a field survey shall be provided by the Certifying Engineer for inclusion with the SWM facility as-built survey.

h. Certification. Seal, signature, license number, and date of license expiration of the PLS who completes the SWM facility as-built survey.

7. Applicable supporting computations demonstrating that the functionality of the SWM facilities and practices meet the approved designs as presented in the approved SWM Report. This is only necessary when tolerances are not met and shall include but is not limited to water surface elevations, freeboard, storage volumes, depths, and other pertinent SWM functionality data that demonstrates the SWM facility performances meets the approved design.

8. A narrative of justification for as-built deviations in SWM facilities and practices.

9. Seal, signature, license number, and date of license expiration of the Certifying Engineer.

1.6 SUBMITTALS AND APPROVAL PROCESS

1. Submittals and Approval Process

   a. Copies of all submission made to the MDE shall be provided to the Owner and Architect.

   b. Partial submittals of the SWM facility as- built package may be made as construction of each individual SWM facility and practice is completed. Otherwise, submit the entire SWM facility as-built package within 45 days of completion of construction activities associated with all SWM facilities and practices but not including establishment of the specified landscaping items. The landscaping phase of SWM facilities and practices need not be completed to submit the SWM facility as-built certification package for Structural Acceptance but is required for Final Approval.

2. Resubmit the SWM facility as-built package with responses to all MDE comments that may be received. Resubmit as many times as necessary, updating the SWM facility as-built package as needed to address all MDE comments, and making any field adjustments as needed to correct deficiencies, until MDE approval is obtained.

1.7 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.8 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Certifying Engineer Documentation: Submit one copy of the Certifying Engineer's resume to the Owner and Architect that includes following information.

1. Name of Certifying Engineer.
2. Maryland professional engineering or professional surveyor license number and expiration date.
3. Name of employer.
4. Contact Information.
5. Relevant work experience.
6. Proof of valid certification of the Maryland Department of the Environment (MDE) Responsible Personnel for Erosion and Sediment Control training course (formerly "Green Card"). Note: All certifications for the former course MDE Responsible Personnel Trailing for Erosion and Sediment Control ("Green Card") expired on December 31, 2016 and are no longer valid.

C. Shop Drawings:

1. Manholes: Include plans, elevations, sections, details, frames, and covers.
2. Weirs and Overflow Structures: Include plans, elevations, sections, and details.
3. Catch basins and stormwater inlets. Include plans, elevations, sections, details, frames, covers, and grates.

D. Shop Drawings:

1. Manholes: Include plans, elevations, sections, details, frames, and covers.
2. Weirs and Overflow Structures: Include plans, elevations, sections, and details.
3. Catch basins and stormwater inlets. Include plans, elevations, sections, details, frames, covers, and grates.

1.9 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer, testing agency.

B. Material and Product Certificates: For each type of material and product used.

C. Material Test Reports: For each material used, by a qualified testing agency.

D. Field quality-control reports.

1.10 REFERENCE DOCUMENTS

A. Maryland Department of the Maryland Approved Stormwater Management and Erosion Control Plans and Permit.

B. Maryland Department of the Environment General Permit for Stormwater Associated with Construction Related Activities.

1.11 QUALITY CONTROL

A. Inspection Agency: Contractor shall engage an independent Inspection Agency for complete inspection and testing of soils and compaction.

B. Notifications: The Contractor is required to notify the Owner and Architect 72 hours prior to the start of construction of Stormwater Management (SWM) Environmental Site Design (ESD) facilities for the purposes of the Maryland Department of the Environment As-Built requirements as indicated on the plans.

PART 2 - PRODUCTS

2.1 STORMWATER MANAGEMNET PRODUCTS AND MATERIALS

A. As indicated on the Contract Documents and Maryland Department of the Environment Approved Plans.

PART 3 - EXECUTION

3.1 STORMWATER MANAGEMENT CONSTRUCTION

A. Obtain the services from and designate a Certifying Engineer prior to beginning construction of SWM facilities and practices.

B. Failure to receive approval for the Certifying Engineer, failure to submit information about the Certifying Engineer designees, or failure of the Certifying Engineer, or the Certifying Engineer designees, to adequately monitor the specified construction activities will be grounds for replacement of the Certifying Engineer and reconstruction of all work on SWM facilities and practices that may have already been performed.

C. Perform all construction activities on SWM facilities and practices only in the presence of the Certifying Engineer or the Certifying Engineer designee. Failure to perform work in the presence of the Certifying Engineer or the Certifying Engineer designee will be grounds for removal and replacement of the Certifying, and reconstruction of all work that may have already been performed.

D. Prior to beginning or continuing construction activities of SWM facilities and practices, ensure the Certifying Engineer or the Certifying Engineer designee is present. If the Certifying Engineer or Certifying Engineer designee is not present, suspend work on SWM facilities and practices and do not resume until the Certifying Engineer or Certifying Engineer designee is present for the activities.

E. Whenever the Certifying Engineer or the Certifying Engineer designee indicates that SWM facilities and practices under construction do not match the Contract Documents, immediately correct the deficiencies before moving to the next construction activity associated with SWM facilities and practices. If it is not possible to correct deficiencies due to the site conditions or

constraints and not due to negligence and inadequate quality of work, cease work on SWM facilities and notify the Owner and Architect.

F. Upon completion of constructing SWM facilities and practices, perform an as-built survey of the completed facility. Complete installation and establishment of landscaping items need not be completed to perform the as-built survey of SWM facilities and practices.

G. Submit the SWM facility as-built certification package. Update SWM facilities as- built surveys when adjustments are made to address comments that may be received.

H. No additional compensation will be considered for addressing comments received on the submitted SWM facilities as-built certification package, revisions to the SWM facility as-built certification package, or any construction activities necessary to address comments that may have been received or necessary to revise the SWM facility as-built certification package.

3.2 RESPONSIBILITY OF THE CERTIFYING ENGINEER

A. Ensure that the Certifying Engineering performs the following:

1. Is present for all activities listed on the SWM as-built certification data tables, performs duties as specified, and records requisite information for the SWM facility as-built certification package. The Certifying Engineer may elect to use a designee as specified in this section. Ensure that the data is available at the Site and on-demand.

2. Prepares written inspection reports for construction activities associated with SWM facilities and practices. The Certifying Engineer may elect to use a designee as specified in this section. The inspection reports must include the following information.

    a. The SWM facility identification number.
    b. The date and location of the activity.
    c. Photographs of the activity with narrative descriptions.
    d. Whether SWM facility construction matches the Contract Documents, noting any deviations from the Contract Documents and how the deviations are addressed. Whenever deviations occur and exceed the specified tolerances, notify the Owner and Architect.

3. Completes the SWM facility as-built certification data tables in the Contract Documents.
4. Takes photographs during construction activities of the SWM facilities and practices and of the completed SWM facilities, including photographs with completed landscape planting installation and establishment. The Certifying Engineer may elect to use a designee as specified in this section.
5. Obtains copies of material approvals for items associated with the SWM facilities and practices. The Certifying Engineer may elect to use a designee as specified in this section.
6. Obtains copies of compaction test results for SWM facility embankments. The Certifying Engineer may elect to use a designee as specified in this section.
7. Alerts the Contractor when the SWM facilities and practices under construction do not match the Contract Documents and MDE approved Plans. The Certifying Engineer may elect to use a designee as specified in this section.
8. When necessary, performs all computations that demonstrate SWM facilities and practices function in the manner as presented in the approved Final SWM Report, including with all revisions to the report that may result from Redline Revisions. At a minimum, the parameters examined by the Certifying Engineer shall include but are not limited to storage volumes, discharge rates, velocities, detention times, water surface

elevations, freeboard, and all other information as recommended by the Certifying Engineer and as requested by the Owner, Architect or MDE.
9. Obtains copies of as-built surveys for the SWM facilities and practices.
10. Prepares the SWM facility as-built certification package.

3.3 STORMWATER MANAGEMENT CONSTRUCTION TOLERANCES

A. All stormwater management facilities shall be built with the specified tolerances:

1. Earthwork. Elevations within 3 in. of elevations specified in the Contract Documents.
2. Embankments, Clay Cores and Cut-off trenches. Elevations not less than the values specified.
3. Drainage Structures. Elevations within 1.2 inches (0.1 feet) of the values specified.
4. Pipe Inverts. Elevations with 1.2 inches (0.1 feet) of the values specified.
5. Riprap. Dimensions within 3 inches of dimensions specified.
6. Freeboard. Not less than the values specified.
7. Volumes. Not less than the values specified.
8. Aggregate, Sand, Bioretention Soil Mix and Mulch Thickness. Not less than the values specified.

B. When construction tolerances cannot be met due to unforeseen site conditions or constraints, ensure that calculations are performed by the Certifying Engineer before proceeding with the next construction activity associated with SWM facilities and practices. If, after performing computations, the Certifying Engineer determines that the SWM facilities do not meet the functional parameters in the approved Final SWM Report as constructed, reconstruct the SWM facilities to meet the functional parameters. If this is not possible due to the site conditions or constraints and not due to negligence and inadequate quality of work, cease work on SWM facilities and notify the Owner and Architect.

C. The Contractor shall make all necessary adjustments and repairs, at no additional cost to the owner, to bring each facility in compliance with the approved designs.

3.4 STORMWATER MANAGEMENT FACILITY MAINTENANCE

A. The Contractor shall be solely responsible for maintenance of all stormwater-related facilities until the Maryland Department of the Environment conducts the closeout inspection and releases the permit. The Contractor shall also perform any required maintenance to the facility to ensure full functionality, and any final required punch-list items as required by Owner, prior to final Owner acceptance of the facility.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Prepare test and inspection reports.

3.6 PROTECTION

A. Protect stormwater management facilities from contamination from sediment.

END OF SECTION

This page is intentionally left blank.

SECTION 33 42 00 - STORMWATER CONVEYANCE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. PE pipe and fittings.
2. PVC pipe and fittings.
3. Concrete pipe and fittings.
4. Non-pressure transition couplings.
5. Cleanouts.
6. Manholes.
7. Catch basins.
8. Pipe outlets.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings:

1. Manholes: Include plans, elevations, sections, details, frames, and covers.
2. Catch basins, stormwater inlets. Include plans, elevations, sections, details, frames, covers, and grates.

1.4 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of cast-iron soil pipe and fitting, from manufacturer.

B. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Do not store plastic manholes, pipe, and fittings in direct sunlight.

B. Protect pipe, pipe fittings, and seals from dirt and damage.

C. Handle manholes in accordance with manufacturer's written rigging instructions.

D. Handle catch basins and stormwater inlets in accordance with manufacturer's written rigging instructions.

1.7 FIELD CONDITIONS

A. Interruption of Existing Storm Drainage Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service in accordance with requirements indicated:

1. Notify Architect no fewer than two days in advance of proposed interruption of service.
2. Do not proceed with interruption of service without Architect's written permission.

PART 2 - PRODUCTS

2.1 CORRUGATED-PE PIPE AND FITTINGS

A. Source Limitations: Obtain corrugated-PE pipe and fittings from single manufacturer.

B. Corrugated-PE Drainage Pipe and Fittings NPS 3 to NPS 10: AASHTO M 252, Type S, with smooth waterway for coupling joints.

C. Corrugated-PE Pipe and Fittings NPS 12 to NPS 60: AASHTO M 294, Type S, with smooth waterway for coupling joints.

D. Corrugated-PE Silttight Couplings: PE sleeve with ASTM D1056, Type 2, Class A, Grade 2 gasket material that mates with pipe and fittings.

E. Corrugated-PE Soiltight Couplings: AASHTO M 294, corrugated, matching pipe and fittings.

2.2 PVC PIPE AND FITTINGS

A. Source Limitations: Obtain PVC pipe and fittings from single manufacturer.

B. NSF Marking: Comply with NSF 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-drain" for plastic storm drain and "NSF-sewer" for plastic storm sewer piping.

C. PVC Piping:

1. Pipe: ASTM D1785, Schedule 40 PVC, with plain ends for solvent-cemented joints.
2. Fittings: ASTM D2466, Schedule 40 PVC, socket type.

D. Adhesive Primer: ASTM F656.

2.3 CONCRETE PIPE AND FITTINGS

A. Source Limitations: Obtain concrete pipe and fittings from single manufacturer.

B. Reinforced-Concrete Sewer Pipe and Fittings: ASTM C76.

1. Bell-and-spigot or tongue-and-groove ends and gasketed joints with ASTM C443, rubber gaskets.
2. Class IV.

2.4 NONPRESSURE TRANSITION COUPLINGS

A. Comply with ASTM C1173, elastomeric, sleeve-type, reducing or transition coupling, for joining underground nonpressure piping. Include ends of same sizes as piping to be joined, and corrosion-resistant-metal tension band and tightening mechanism on each end.

B. Sleeve Materials:

1. For Concrete Pipes: ASTM C443, rubber.
2. For Plastic Pipes: ASTM F477, elastomeric seal or ASTM D5926, PVC.
3. For Dissimilar Pipes: ASTM D5926, PVC or other material compatible with pipe materials being joined.

C. Unshielded, Flexible Couplings:
1. Source Limitations: Obtain unshielded, flexible couplings from single manufacturer.
2. Description: Elastomeric sleeve with stainless-steel shear ring and corrosion-resistant-metal tension band and tightening mechanism on each end.

D. Shielded, Flexible Couplings:
1. Source Limitations: Obtain shielded, flexible couplings from single manufacturer.
2. Description: ASTM C1460, elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.

E. Ring-Type, Flexible Couplings:
1. Source Limitations: Obtain ring-type, flexible couplings from single manufacturer.
2. Description: Elastomeric compression seal with dimensions to fit inside bell of larger pipe and for spigot of smaller pipe to fit inside ring.

2.5 CLEANOUTS

A. PVC Cleanouts:

1. Source Limitations: Obtain PVC cleanouts from single manufacturer.
2. Description: PVC body with PVC threaded plug. Include PVC sewer pipe fitting and riser to cleanout of same material as sewer piping.

2.6 MANHOLES

A. Standard Precast Concrete Manholes:

1. Description: ASTM C478, precast, reinforced concrete, of depth indicated, with provision for sealant joints.
2. Diameter: 48 inches minimum unless otherwise indicated.
3. Ballast: Increase thickness of precast concrete sections or add concrete to base section as required to prevent flotation.

4. Base Section: 6-inch minimum thickness for floor slab and 4-inch minimum thickness for walls and base riser section, and separate base slab or base section with integral floor.
5. Riser Sections: 4-inch minimum thickness, and lengths to provide depth indicated.
6. Top Section: Eccentric-cone type unless concentric-cone or flat-slab-top type is indicated, and top of cone of size that matches grade rings.
7. Joint Sealant: ASTM C990, bitumen or butyl rubber.
8. Resilient Pipe Connectors: ASTM C923, cast or fitted into manhole walls, for each pipe connection.
9. Steps: Individual FRP steps; FRP ladder; or ASTM A615/A615M, deformed, 1/2-inch steel reinforcing rods encased in ASTM D4101, PP, wide enough to allow worker to place both feet on one step and designed to prevent lateral slippage off step. Cast or anchor steps into sidewalls at 12- to 16-inch intervals. Omit steps if total depth from floor of manhole to finished grade is less than 60 inches.
10. Grade Rings: Reinforced-concrete rings, 6- to 9-inch total thickness, to match diameter of manhole frame and cover, and height as required to adjust manhole frame and cover to indicated elevation and slope.

B. Manhole Frames and Covers:

1. Description: Ferrous; 24-inch ID by 7- to 9-inch riser with 4-inch- minimum width flange and 26-inch- diameter cover. Include indented top design with lettering cast into cover, using wording equivalent to "STORM SEWER."
2. Material: ASTM A536, Grade 60-40-18 ductile iron unless otherwise indicated.

2.7 CONCRETE

A. General: Cast-in-place concrete in accordance with ACI 318, ACI 350, and the following:

1. Cement: ASTM C150/C150M, Type II.
2. Fine Aggregate: ASTM C33/C33M, sand.
3. Coarse Aggregate: ASTM C33/C33M, crushed gravel.
4. Water: Potable.

B. Portland Cement Design Mix: 4000 psi minimum, with 0.45 maximum water/cementitious materials ratio.

1. Reinforcing Fabric: ASTM A1064/A1064M, steel, welded wire fabric, plain.
2. Reinforcing Bars: ASTM A615/A615M, Grade 60 (420 MPa) deformed steel.

C. Manhole Channels and Benches: Factory or field formed from concrete. Portland cement design mix, 4000 psi minimum, with 0.45 maximum water/cementitious materials ratio. Include channels and benches in manholes.

1. Channels: Concrete invert, formed to same width as connected piping, with height of vertical sides to three-fourths of pipe diameter. Form curved channels with smooth, uniform radius and slope.

    a. Invert Slope: 1 percent through manhole.

2. Benches: Concrete, sloped to drain into channel.

    a. Slope: 4 percent.

D. Ballast and Pipe Supports: Portland cement design mix, 3000 psi minimum, with 0.58 maximum water/cementitious materials ratio.

1. Reinforcing Fabric: ASTM A1064/A1064M, steel, welded wire fabric, plain.
2. Reinforcing Bars: ASTM A615/A615M, Grade 60 (420 MPa) deformed steel.

2.8 CATCH BASINS

A. Standard Precast Concrete Catch Basins:

1. Description: ASTM C478, precast, reinforced concrete, of depth indicated, with provision for sealant joints.
2. Base Section: 6-inch minimum thickness for floor slab and 4-inch minimum thickness for walls and base riser section, and separate base slab or base section with integral floor.
3. Riser Sections: 4-inch minimum thickness, 48-inch diameter, and lengths to provide depth indicated.
4. Top Section: Eccentric-cone type unless concentric-cone or flat-slab-top type is indicated. Top of cone of size that matches grade rings.
5. Joint Sealant: ASTM C990, bitumen or butyl rubber.
6. Grade Rings: Include two or three reinforced-concrete rings, of 6- to 9-inch total thickness, that match 24-inch- diameter frame and grate.
7. Steps: Individual FRP steps; FRP ladder; or ASTM A615/A615M, deformed, 1/2-inch steel reinforcing rods encased in ASTM D4101, PP, wide enough to allow worker to place both feet on one step and designed to prevent lateral slippage off step. Cast or anchor steps into sidewalls at 12- to 16-inch intervals. Omit steps if total depth from floor of catch basin to finished grade is less than 60 inches.
8. Pipe Connectors: ASTM C923, resilient, of size required, for each pipe connecting to base section.

B. Frames and Grates: ASTM A536, Grade 60-40-18, ductile iron designed for A-16 (AASHTO HS20-44), structural loading. Include flat grate with small square or short-slotted drainage openings.

1. Size: 24 by 24 inches minimum unless otherwise indicated.
2. Grate Free Area: Approximately 50 percent unless otherwise indicated.

C. Frames and Grates: ASTM A536, Grade 60-40-18, ductile iron designed for A-16 (AASHTO HS20-44), structural loading. Include 24-inch ID by 7- to 9-inch riser with 4-inch-minimum width flange, and 26-inch- diameter flat grate with small square or short-slotted drainage openings.

1. Grate Free Area: Approximately 50 percent unless otherwise indicated.

2.9 PIPE OUTLETS

A. Head Walls: Cast-in-place reinforced concrete, with apron and tapered sides.

B. Riprap Basins: Broken, irregularly sized and shaped, graded stone in accordance with Maryland Department of Environment Soil Erosion and Sediment Control Standards and Specifications.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Excavation, trenching, and backfilling are specified in Section 312000 "Earth Moving."

3.2 PIPING INSTALLATION

A. General Locations and Arrangements: Drawing plans and details indicate general location and arrangement of underground storm drainage piping. Location and arrangement of piping layout take into account design considerations. Install piping as indicated, to extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.

B. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings in accordance with manufacturer's written instructions for use of lubricants, cements, and other installation requirements.

C. Install manholes for changes in direction unless fittings are indicated. Use fittings for branch connections unless direct tap into existing sewer is indicated.

D. Install proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.

E. Install gravity-flow, nonpressure drainage piping in accordance with the following:

1. Install piping pitched down in direction of flow.
2. Install piping NPS 6 and larger with restrained joints at tee fittings and at changes in direction. Use corrosion-resistant rods, pipe or fitting manufacturer's proprietary restraint system, or cast-in-place concrete supports or anchors.
3. Install piping with 36-inch-minimum cover.
4. Install PE corrugated sewer piping in accordance with ASTM D2321.
5. Install PVC piping in accordance with ASTM D2321 and ASTM F1668.
6. Install reinforced-concrete sewer piping in accordance with ASTM C1479 and ACPA's "Concrete Pipe Installation Manual."

3.3 PIPE JOINT CONSTRUCTION

A. Join gravity-flow, nonpressure drainage piping in accordance with the following:
1. Join corrugated-PE piping in accordance with ASTM D3212 for push-on joints.
2. Join PVC piping in accordance with ASTM D2321 and ASTM F891 for solvent-cemented joints.
3. Join reinforced-concrete sewer piping in accordance with ACPA's "Concrete Pipe Installation Manual" for rubber-gasketed joints.
4. Join dissimilar pipe materials with nonpressure-type flexible couplings.

3.4 CLEANOUT INSTALLATION

A. Install cleanouts and riser extensions from sewer pipes to cleanouts at grade. Use cast-iron soil pipe fittings in sewer pipes at branches for cleanouts and cast-iron soil pipe for riser extensions to cleanouts. Install piping so cleanouts open in direction of flow in sewer pipe.

1. Use Light-Duty, top-loading classification cleanouts in earth or unpaved foot-traffic areas.

B. Set cleanout frames and covers as shown.

3.5 MANHOLE INSTALLATION

A. General: Install manholes, complete with appurtenances and accessories indicated.

B. Install precast concrete manhole sections with sealants in accordance with ASTM C891.

C. Where specific manhole construction is not indicated, follow manhole manufacturer's written instructions.

D. Set tops of frames and covers flush with finished surface of manholes that occur in pavements. Set tops 3 inches above finished surface elsewhere unless otherwise indicated.

3.6 CATCH BASIN INSTALLATION

A. Construct catch basins to sizes and shapes indicated.

B. Set frames and grates to elevations indicated.

3.7 STORMWATER OUTLET INSTALLATION

A. Construct inlet head walls, aprons, and sides of reinforced concrete, as indicated.

B. Construct riprap of broken stone, as indicated.

C. Install outlets that spill onto grade, anchored with concrete, where indicated.

D. Install outlets that spill onto grade, with flared end sections that match pipe, where indicated.

3.8 CONCRETE PLACEMENT

A. Place cast-in-place concrete in accordance with ACI 318.

3.9 CONNECTIONS

A. Connect nonpressure, gravity-flow drainage piping in building's storm building drains specified in Section 221413 "Facility Storm Drainage Piping."

B. Make connections to existing piping and underground manholes.

1. Use commercially manufactured wye fittings for piping branch connections. Remove section of existing pipe; install wye fitting into existing piping; and encase entire wye fitting, plus 6-inch overlap, with not less than 6 inches of concrete with 28-day compressive strength of 3000 psi.
2. Make branch connections from side into existing piping, NPS 4 to NPS 20. Remove section of existing pipe, install wye fitting into existing piping, and encase entire wye with not less than 6 inches of concrete with 28-day compressive strength of 3000 psi.

3. Make branch connections from side into existing piping, NPS 21 or larger, or to underground manholes and structures by cutting into existing unit and creating an opening large enough to allow 3 inches of concrete to be packed around entering connection. Cut end of connection pipe passing through pipe or structure wall to conform to shape of and be flush with inside wall unless otherwise indicated. On outside of pipe, manhole, or structure wall, encase entering connection in 6 inches of concrete for minimum length of 12 inches to provide additional support of collar from connection to undisturbed ground.

    a. Use concrete that will attain a minimum 28-day compressive strength of 3000 psi unless otherwise indicated.
    b. Use epoxy-bonding compound as interface between new and existing concrete and piping materials.

4. Protect existing piping, manholes, and structures to prevent concrete or debris from entering while making tap connections. Remove debris or other extraneous material that may accumulate.

C. Pipe couplings, expansion joints, and deflection fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.

1. Use nonpressure-type flexible couplings where required to join gravity-flow, nonpressure sewer piping unless otherwise indicated.

3.10 CLOSING ABANDONED STORM DRAINAGE SYSTEMS

A. Abandoned Piping: Close open ends of abandoned underground piping indicated to remain in place. Include closures strong enough to withstand hydrostatic and earth pressures that may result after ends of abandoned piping have been closed. Use either procedure below:

1. Close open ends of piping with at least 8-inch- thick, brick masonry bulkheads.
2. Close open ends of piping with threaded metal caps, plastic plugs, or other acceptable methods suitable for size and type of material being closed. Do not use wood plugs.

B. Backfill to grade in accordance with Section 312000 "Earth Moving."

3.11 IDENTIFICATION

A. Materials and their installation are specified in Section 312000 "Earth Moving." Arrange for installation of green warning tape directly over piping and at outside edge of underground structures.

1. Use warning tape or detectable warning tape over ferrous piping.
2. Use detectable warning tape over nonferrous piping and over edges of underground structures.

3.12 FIELD QUALITY CONTROL

A. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches of backfill is in place, and again at completion of Project.

1. Submit separate reports for each system inspection.

2. Defects requiring correction include the following:

    a. Alignment: Less than full diameter of inside of pipe is visible between structures.
    b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.
    c. Damage: Crushed, broken, cracked, or otherwise damaged piping.
    d. Infiltration: Water leakage into piping.
    e. Exfiltration: Water leakage from or around piping.

3. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
4. Reinspect and repeat procedure until results are satisfactory.

B. Test new piping systems, and parts of existing systems that have been altered, extended, or repaired, for leaks and defects.

1. Do not enclose, cover, or put into service before inspection and approval.
2. Test completed piping systems in accordance with requirements of authorities having jurisdiction.
3. Schedule tests and inspections by authorities having jurisdiction with at least 24 hours' advance notice.
4. Submit separate report for each test.
5. Gravity-Flow Storm Drainage Piping: Test in accordance with requirements of authorities having jurisdiction, UNI-B-6, and the following:

    a. Exception: Piping with soiltight joints unless required by authorities having jurisdiction.
    b. Option: Test plastic piping in accordance with ASTM F1417.

C. Leaks and loss in test pressure constitute defects that must be repaired.

D. Replace leaking piping using new materials, and repeat testing until leakage is within allowances specified.

3.13 CLEANING

A. Clean interior of piping of dirt and superfluous materials. Flush with potable water.

END OF SECTION

This page is intentionally left blank.